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ELY (R. E.), MOORE (L. A.), HUBANKS (P. E.), CARTER (R. H.) & POOS (F. W.). **Results of feeding Methoxychlor sprayed Forage and crystalline Methoxychlor to Dairy Cows.**—*J. Dairy Sci.* **36** no. 3 pp. 309–314, 21 refs. Lancaster, Pa., 1953.

The following is based on the authors' summary. Two lots of hay that were harvested in 1950 from lucerne sprayed with 0·5 and 1 lb. p,p'methoxy-DDT per acre and bore average residues of 16·1 and 91·6 parts methoxy-DDT per million, respectively, and two similar lots that were harvested in 1951 from lucerne sprayed with 0·48 and 1·94 lb. per acre and bore residues of 31·5 and 109 p.p.m., respectively, were fed as their sole diet to dairy cows. No methoxy-DDT was detected in the milk. When crystalline methoxy-DDT was administered orally as a 10 per cent. solution in soy-bean oil in daily doses equivalent to over 500 p.p.m. of the feed consumed, detectable amounts of methoxy-DDT occurred in the milk, and the milk of one cow had 1·16 p.p.m. in the fat-corrected milk while receiving methoxy-DDT equivalent to over 2,000 p.p.m. of the feed consumed. The percentages of the total doses of methoxy-DDT ingested that were secreted in the milk did not exceed 0·48. It is concluded that about a hundred times as much methoxy-DDT as DDT [*cf. R.A.E.*, A **41** 66] must be administered orally to be detectable in cows' milk and that feeding on hay from lucerne sprayed with methoxy-DDT at recommended rates is most unlikely to lead to milk contamination.

NIRULA (K. K.), ANTONY (J.), SAHASRANAMAN (K. N.) & MENON (K. P. V.). **Observations on the Biology and Control of** *Contheyla rotunda* **H.**—*Indian Cocon. J.* **7** no. 4 pp. 143–155, 5 figs., 10 refs. Ernakulam, 1954.

The Limacodid, *Contheyla rotunda* Hmps., all stages of which are described, is a minor pest of coconut in India that sometimes occurs in outbreak numbers. It is commonest in restricted areas along the western coast as far north as Kanara [*cf. R.A.E.*, A **7** 506; **26** 452; **32** 411] and also occurs inland [**24** 41]. It breeds mainly on coconut, but the larvae also develop on other plants during outbreaks, including tea [*cf.* **32** 411]. As a result of larval feeding, the palms may be completely defoliated, and the spathes, flowering shoots and nuts are also damaged. Defoliated palms produce small, weak leaves and few or no flower spikes, and the nuts fall prematurely. Loss of crop is sometimes as high as 75 per cent., and is greatest in the year following maximum defoliation. All the palms on an island in Travancore-Cochin were defoliated in two months during a severe outbreak in the summer of 1953.

In laboratory rearing experiments, the eggs were laid in groups of 4–15 on the lower surface of the leaflets. The females laid an average of 215 eggs, but they are apparently not all deposited on one palm unless the trees are widely spaced. The egg and larval stages and the combined prepupal and pupal stages lasted 3–6, 27–48 and 10–14 days, respectively. Larval development is accelerated during the hot months of March–May and when food is scarce, and, in the latter case, the next generation is short-lived. Pupation took place within a cocoon constructed close to the mid-rib of the leaflet. The adults, which are diurnal and incapable of extensive flight, are strongly attracted to light by day, but not by night; they are little affected by wind, but many are drowned during very heavy rains. In the field, both sexes feed on the nectar of coconut flowers, but they did not readily feed in the laboratory, and since several generations can develop in plantations too young to flower, food appears not to be

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essential. Mating usually takes place on the day after the emergence of the females; in the laboratory, oviposition began after not more than four days and continued for 1–4 days. The tallest palms are attacked first, and seedlings and young plants do not become infested until several generations have developed. Males were slightly more numerous than females. Parasites reared from the pupae comprised *Chrysis* sp., which was common throughout the year, sometimes affording 20 per cent. parasitism, and of which the life-cycle lasted an average of 12 days, and *Antrocephalus* sp., which gave up to 3 per cent. parasitism; *Rogas* sp. parasitised larvae in the second and third instars, but parasitism rarely exceeded 5 per cent. During heavy rains, the larvae and pupae are attacked by bacteria, which cause mortality high enough to control severe outbreaks, and fungi, which, however, are mostly saprophytic.

The only large-scale control measure hitherto considered practicable was the burning of infested leaves, but in view of the successful use of DDT sprays against *Nephantis serinopa* Meyr. [*cf.* **43** 231], both DDT and BHC were tested in 1953. When the leaves of young coconut palms on which fifth-instar larvae had been liberated 24 hours earlier were sprayed and the larvae subsequently removed and kept under observation, complete mortality was given by BHC at 0·2 per cent. after 12 hours, by BHC at 0·1 and 0·05 per cent. and DDT at 0·2 per cent. after 24 hours, and by DDT at 0·1 and 0·05 per cent. after 48 hours. Since BHC is less persistent than DDT, the latter was used in a field test on the infested island, and a spray of 0·1 per cent. DDT reduced the mean numbers of larvae and pupae per leaf from 1,131 and 35, respectively, before treatment to 2 and 6 two weeks after it. Some of the pupae were found to be attacked by a fungus, and pathogenic bacteria and fungi may have been responsible for part of the reduction.

KALSHOVEN (L. G. E.). **Scolytids in Relation to premature Death of Nutmeg Trees** (*Myristica*) **in Sumatra.**—*Contr. gen. agric. Res. Sta. Bogor* no. 140, 16 pp., 21 refs. Bogor, 1954. (With a Summary in Indonesian.)

Nutmeg trees (*Myristica fragrans*) in western Sumatra were subject to sudden die-back and death in 1930, 1933 and later, and the condition was apparently associated with infestation by Scolytid bark-borers. Material collected from nutmeg branches in 1937 comprised *Phlocosinus cribratus* Bldf. [*cf. R.A.E.*, A **1** 351] and *Dacryphalus sumatranus* Schedl [**27** 512]. The habits of these and related species are discussed, and early reports of premature death of nutmeg trees in various parts of the Indo-Malayan area are reviewed. It is concluded that the real cause is as yet unknown.

MAY (A. W. S.) & PASSLOW (T.). **Insecticidal Control of** *Agrotis infusa* **(Boisd.) and** *Leucania unipuncta* **(Haw.) in Field Crops.**—*Qd J. agric. Sci.* **11** no. 1 pp. 1–14, 2 figs., 10 refs. Brisbane, 1954.

Euxoa (*Agrotis*) *infusa* (Boisd.) and *Pseudaletia* (*Leucania*) *unipuncta* (Haw.) damaged a wide range of crops in southern Queensland during July–August 1952, and since the arsenical baits [*cf. R.A.E.*, A **24** 620] and mechanical barriers hitherto used against such insects are laborious and difficult to apply, sprays of DDT were tested against both species, and other organic insecticides against *E. infusa*. The amounts of toxicants given were applied in 100 gals. spray per acre. In the tests against *E. infusa*, p,p′DDT applied to seedling lucerne at 0·15–1 lb. in emulsified

solutions significantly increased the numbers of dead larvae found and the yield of hay, but there was no significant difference between concentrations. In a further test, DDT at 0·25 lb. gave lower mortality and acted more slowly than at higher concentrations, and there was some evidence that sub-lethal doses repelled the larvae. When similar sprays were applied to seedling wheat heavily infested with late-instar larvae, significant increases were obtained in yield of both straw and grain. On oats infested by *P. unipuncta* in autumn and spring, DDT at all four rates almost entirely prevented further damage. Its action was slower at 0·5 lb. than at higher rates, though mortality of larvae collected for observation was relatively satisfactory four days after treatment; at 0·25 lb., it permitted some larvae to pupate normally. Significant increases in yield were not always obtained, but spraying was nevertheless considered to be justifiable; there was no significant difference between treatments.

In comparative tests against *E. infusa* on lucerne, DDT, dieldrin, aldrin, chlordane and toxaphene were applied in emulsion sprays at 0·25 lb. and BHC (in a wettable-powder spray) and parathion (in an emulsion spray) at 0·2 and 0·1 lb., respectively; counts of dead larvae were made after two and four days. DDT, dieldrin and aldrin resulted in significantly higher mortality than the other materials and no treatment, and the highest yield was obtained from the plot sprayed with DDT, though the increase was not significant. In similar tests on barley, in which the rates of application of toxaphene, BHC and parathion were changed to 0·2, 0·25 and 0·1 lb., respectively, significant mortality was given by DDT, dieldrin, aldrin and toxaphene, but damage prior to treatment was too extensive for yield data to be reliable.

In general, the severity of the damage by both insects appeared to depend on the age at which the crop was attacked, and was greatest on seedlings. Lucerne attacked by *E. infusa* before the crowns had developed was completely destroyed, but older plants and cereals that were attacked after tillering had begun were only defoliated, though late-instar larvae of *P. unipuncta* sometimes reduced yields in cereals by biting through the stems immediately below the heads.

On the basis of these trials, a spray of DDT at 0·5 lb. per acre was recommended against both species and gave good results when used on a commercial scale in 1952 and 1953.

GARDNER (J. C. M.) & EVANS (J. O.). **Notes on *Oemida gahani* Distant (Cerambycidae); with a Note by H. H. C. Pudden.**—*E. Afr. agric. J.* **18** no. 4 pp. 176–183, 4 refs. Nairobi, 1953.

Oemida gahani (Dist.), which was described from the Transvaal in 1892 but has not been recorded there since 1904, has been found to cause considerable damage to introduced conifers in plantations in Kenya. This Cerambycid, the egg, larva and adults of which are described, also occurs in Tanganyika, but has not so far proved injurious there, and it was found in a fallen tree on the Uganda side of Mount Elgon in 1952. In Kenya, where it was already known to damage structural timbers of *Podocarpus gracilior* [*cf. R.A.E.*, A **28** 311], the only living trees in which it has been found to complete its development are *Cupressus* spp. and *Juniperus procera*, though dead trees, stumps and logs, of several species, a list of which is given, are infested.

Living trees are attacked at sites where dead wood is exposed, such as scars resulting from pruning or injury by animals, and the females, which lay their eggs in batches, often of about 20, in crevices, frequently oviposit on pruning scars on *Cupressus*. A maximum of 131 eggs was dissected

from an unfertilised female. The eggs hatch in 36–57 days, and the larvae enter the wood and bore vertically in the main stem, avoiding the living sapwood, so that the tree shows no signs of infestation. In dead trees and timber, the larval galleries are sometimes found beneath the bark and then resemble those caused by *Chlorophorus carinatus* Auriv. Characters distinguishing the two Cerambycids are described. Structural timbers are riddled with galleries, but show relatively few exit holes on the surface. The shortest period of development observed was two years from egg to adult, in freshly felled *Cupressus* under room conditions, and the development period is likely to be prolonged in very dry wood. Peaks of adult emergence occurred during the months of maximum rainfall (April and October–November). Populations were high in dead wood, one dead cypress showing an average of 249 larvae, pupae and exit holes per cu. ft., with a maximum of 406.

Natural enemies reared from heavily infested wood comprised species of *Neostephanus*, *Biphymaphorus*, *Metapelma*, *Alindria*, *Isocymatodera* and *Bothrideres*, but they occurred in numbers that were small in relation to those of *O. gahani*. It is suggested that it may be advisable, for control, to increase the proportion of pines, which appear to be resistant to attack, in new plantations, to improve the technique of pruning so as to leave a smaller scar, and to protect the scars by painting with chemicals. It may be advisable to fell the whole of a plantation as soon as infestation is detected, as the timber yield will in any case be affected and large populations of *Oemida* will build up if the trees are allowed to stand. Good forest sanitation is essential. Infested logs should be dealt with immediately, and charcoal-making appears to be a satisfactory and economic method of disposal. Pruning techniques are discussed in the supplementary note.

TAPLEY (R. G.). **A Note on Mites as new Pests of *Coffea arabica* in Tanganyika.**—*E. Afr. agric. J.* **18** no. 4 pp. 191–192, 5 refs. Nairobi, 1953.

In 1950, the leaves of coffee at Lyamungu, Tanganyika, were found to be distorted, and mites were observed, sometimes in large numbers, on the lower surfaces of the young foliage. They included both phytophagous and predacious species, and those that were probably responsible for the damage were identified as *Hemitarsonemus latus* (Banks), which was the most numerous, *Brevipalpus phoenicis* (Geijskes) and a species of *Tydeus*, probably *T. caudatus* (Dugès). *H. latus* is cosmopolitan and is believed to be widespread in the Northern Province of Tanganyika, but it has not apparently been previously recorded from coffee. The other two species were rare. Since the outbreak may have been due to the use of DDT sprays against *Antestia* and thrips on coffee, pyrethrum should be used instead of DDT where outbreaks occur.

KOCKUM (S.). **Protection of Cob Maize stored in Cribs.**—*E. Afr. agric. J.* **19** no. 2 pp. 69–73, 1 ref. Nairobi, 1953.

In connection with studies in Kenya on the protection of maize from insect attack [*cf. R.A.E.*, A **42** 251], an experiment was made in 1952 on the control of infestation while the cobs are stored in cribs, before shelling. *Calandra oryzae* (L.) and *Sitotroga cerealella* (Ol.) are the main pests responsible for the damage, the former being the more injurious, and the grain is already infested when brought in from the field. The experiment was carried out in two wire-netting cribs 36 × 9 × 9 ft., each divided into

12 compartments, of which the outer ones were not used, and the cobs were treated with a dust blower as they were put into the compartments, at the rate of 8 oz. dust per 9 cu. ft. of crib space. The grain was removed from the cobs after six months and weighed, and it was found that the average weights in lb. per compartment, as compared with 3,919 for no treatment, were 3,960 for diatomite, 4,375 for 0·04 per cent. γ BHC in diatomite, 4,722 for a proprietary mixture of pyrethrum and diatomite (1:3), and 5,069 for 0·4 per cent. γ BHC in diatomite. The difference between the two concentrations of BHC was significant, and the higher concentration and the pyrethrum product were both significantly better than diatomite or no treatment. The percentages of grains injured in samples from various positions in the compartments are shown in a table and analysed statistically. They averaged 59, 40, 28 and 22 for the four materials, respectively, as compared with 62 for no treatment.

At the time of the experiment, the maximum amount of γ BHC permitted for treatment of grain in Kenya was one part per million. However, investigations in which about 10 and 100 p.p.m. γ BHC were applied to maize cobs showed that grain that had been removed and passed over a shaking grading tray did not contain more than 2·5 and 1·5 p.p.m., respectively. In view of these results, an increase in the permitted dosage to 12·5 p.p.m. for cribbed maize was recommended.

DUERDEN (J. C.). **Stem Borers of Cereal Crops at Kongwa, Tanganyika, 1950–52.**—*E. Afr. agric. J.* **19** no. 2 pp. 105–119, 6 graphs, 2 refs. Nairobi, 1953. **Corrigendum.**—*T. c.* no. 4 p. 211. 1954.

At Kongwa, in the Central Province of Tanganyika, serious damage is caused to cereals, particularly maize and sorghum, by the stem borers, *Busseola fusca* (Fuller) and *Chilo zonellus* (Swinh.), both of which occur in each food-plant. The former is a pest of maize in South Africa, and the latter, which is common on sorghum and sugar-cane in India, is believed not to have been recorded previously from Africa [but *cf.* next abstract]. The losses result from destruction of the seedlings, a reduction in the yield of grain per plant, and weakening of the stem that causes lodging just before harvest. In 1949–50, 1950–51 and 1951–52, the average percentages of plants infested were 30, 45 and 30, respectively, for maize and 35, 90–100 and 35 for sorghum. When plots of maize were kept free from infestation by weekly dusting with DDT in 1952, the yield of grain was increased to 1,916 lb. per acre, as compared with 1,326 lb. from untreated maize. Tables are given showing the numbers of larvae and pupae per acre and the percentages of plants infested in maize and sorghum crops of several varieties, planted on various dates in 1949–50. Infestation was heavier on sorghum than on maize, and peak populations on the two crops were reached at about the end of June and in mid-June, respectively.

The two species have very similar habits. The first eggs are laid when the plants are about 4 ins. high, under the leaf sheaths or in the cavity in the whorl before the stem begins to elongate. On hatching, the larvae feed for a short time on the extended leaves, and some migrate to other plants. Boring in the stem then begins, and it is during these initial stages that most of the losses occur. In 1952, 10 per cent. of the young maize plants were destroyed in the first month after sowing and 30 per cent. of the sorghum plants were destroyed in the first five weeks. Graphs are given showing the fluctuations in the larval and pupal populations in 1951. On maize sown in January there were five peaks of larval infestation at intervals of about four weeks, the last occurring after harvest, which was in early July, and there were three peaks in the numbers of pupae, with a possible

fourth in mid-June. Pupae were rare in September–October, but some were found in November. There were also probably five peaks of larval infestation on sorghum sown in early February, but only one in the numbers of pupae. Small numbers of adults emerged in the dry season, but investigations showed that the majority of the population survived as larvae in tillers and self-sown plants, which remain green during the post-harvest period. During counts of the population in such plants, analyses were made of the height at which the larvae and pupae were found in the stem, and the results are shown on graphs. No downward migration of the larvae was observed in either the growing season or the dry season such as has been reported for *B. fusca* in South Africa [*cf. R.A.E.*, A **24** 449; **32** 231], possibly because climatic conditions in Tanganyika are less severe, and the finding of only small numbers of larvae and pupae in the base of the plants in September–October suggests that destruction of the aerial parts of the plants alone might give effective control.

In experiments on control at Kongwa, ploughing in the crop residues proved unsatisfactory since it was impossible to obtain complete burial of the trash, and ploughing was in some soils not possible until the beginning of the rains in December, by which time adult emergence has already begun. The use of trap crops was not practicable because of the shortness of the rainy season. In one test, when maize was sown as a trap crop in late December, only 10 per cent. of the plants were infested 41 days later, when they should have been destroyed, and the infestation did not rise to a more suitable level (29 per cent.) for a further 20 days, by which time over 10 per cent. of the main crop was infested. Other tests showed that the degree of infestation was not affected by the variety of sorghum or maize sown, the spacing of the maize rows, the amount of phosphatic fertiliser applied to sorghum, the time of sowing or the grazing of cattle on the maize residues. The best method of control was the burning of the stalks during the dry season. In 1952, the total percentage of maize plants attacked was 15·5 in a field in which the stalks had been burnt during the previous dry season and 27·3 in one in which they had not. Maize stalks must be either stooked or windrowed after harvest, as they will not normally burn in the state in which they are left in the field after either hand or mechanical picking. Windrowing was also found to give the best results with sorghum. In a test in 1951, burning sorghum stalks in October destroyed 99·6 per cent. of the borer population in them. The stubble from a semi-giant variety of sorghum that had been harvested by combine burned satisfactorily without windrowing and 80 per cent. reduction in the borer population was obtained. In a test with insecticides in 1952, treatment of sorghum three weeks after sowing with a 3 per cent. dust of DDT at 20–25 lb. per acre and sprays of 0·5 per cent. derris or 0·1 per cent. parathion at 20 gals. per acre gave unsatisfactory results, possibly owing to reinfestation. The only parasite observed was the Ichneumonid, *Chasmias* sp., which was reared from pupae of *B. fusca* but is thought to afford little control.

MARTIN (E. L.). **Notes on the Status of some Species of Crambinae (Lepidoptera: Pyralidae).**—*Entomologist* **87** no. 1092–1093 pp. 117–121, 20 figs., 11 refs. London, 1954.

Notes are given on the synonymy or generic position of 14 species, in order to supply a basis for information given with recently identified material, together with figures of the genitalia if not previously published. The species include *Diatraea argyrolepia* Hmps. and *D. polychrysa* Meyr., which are transferred to *Chilotraca*, and *Chilo zonellus* (Swinh.), of which

Argyria lutulentalis Tams is a synonym. *A. lutulentalis* was described from Nyasaland in 1932.

DUERDEN (J. C.) & EVANS (A. C.). **A Note on the Biology of *Calidea dregei* Germ.**—*E. Afr. agric. J.* **19** no. 3 pp. 188–192. Nairobi, 1954.

In Tanganyika, severe damage to the seeds by *Calidea dregii* Germ., which is a well-known pest of cotton, occurred on experimental plots of sorghum and sunflower [*Helianthus annuus*] at Kongwa in 1948 and on large-scale plantings of sunflower at Urambo in 1949, and observations were made on the bionomics of this Pentatomid and the injury caused. At Kongwa in 1948, adults were first observed on the developing heads of sunflower and sorghum in March. The females were ready to oviposit by April, but no eggs were laid on either crop and nymphs were observed only on a species of *Hibiscus*, probably *H. mastersianus*. Adults developed on this plant in June but migrated almost immediately, mostly to late-planted sunflower, though some were found on the developing pods of leguminous plants and on castor [*Ricinus communis*], cotton and safflower [*Carthamus tinctorius*]. The adults possessed well-developed fat-bodies, but no ovarial development occurred and a resting period was apparently imminent. In 1949, adults were observed pairing near Kongwa on 14th January, and adults of the same or a subsequent generation were abundant on the heads of sunflower by the end of March. Newly hatched nymphs were found on sunflower from 8th April to 13th May. The eggs were laid in batches between the florets, and counts in mid-April showed 11,000 adults and 8,500 eggs per acre in one field and 5,000 and 200 per acre, respectively, in another. On sorghum, the eggs were laid in batches averaging 28, in rings round the stalks or dried-up leaves, but conditions were evidently unsuitable, as counts on experimental plots showed only 800 eggs, as compared with 18,000 adults per acre, and few nymphs developed. The nymphal stage lasted about 50 days in April–June. Pairing was observed in December 1949 and January 1950, and oviposition began 5–11 days later. The eggs hatched in 7–11 days, with an average of about nine days, when kept in ventilated jars at shade temperatures, and the five nymphal instars were completed in averages of 6, 6, 8, 11 and 17 days, respectively. There appeared to be three main generations a year, present in January–April, March–July and June–December, respectively, but all stages of development have been found throughout the year.

C. dregii is highly polyphagous, and a list is given showing the wild and cultivated plants on which it has been observed, or is believed, to feed. After harvest, the bugs move to any plants that remain succulent, feeding on very late or perennial crops such as castor. By late October, the main food-plants are reduced to castor and hedges of *Euphorbia tirucalli* round houses and gardens. Dissection showed that ovarial development did not begin until mid-December. After the first rains, at the end of November and the beginning of December, regenerated sorghum stubble and the native *Crotalaria laburnifolia* and *Solanum panduriforme* serve as the first food-plants. From mid-January, populations begin to build up on self-sown sunflower and sunn-hemp [*Crotalaria juncea*] and the wild *Combretum longispicatum*. The build-up continued on sown crops, especially sorghum and sunflower, in February–March, and large numbers of adults were present on the young heads in late March and early April. From early March, equally large numbers were present on cotton, even in isolated plantings, in association with *Dysdercus* spp. On sorghum, the grain is apparently preferred in the milky stage, and late-sown crops were attacked in May and June, almost

up to harvest. Comparable development probably takes place in the natural bush.

Studies on the damage caused to sunflower seeds were made at Urambo in 1949. The husks showed no external signs of injury, and it appeared that the bug fed on the kernel by inserting its proboscis through the micropyle, causing damage that varied from slight wrinkling at the broad end to almost complete destruction. Analysis showed that the injury affected the percentage of oil, which was reduced from 26–29 for normal seed to 21·9–24·2 and 16·7–17 for samples containing 58·1–63·5 and 32·9–34·4 per cent. undamaged seeds, respectively. There was a decrease in the weight of the kernels and an increase in husk weight for all categories of damage, which suggests that the forcing of the micropyle is in the nature of a wound and results in callus formation. Severe damage markedly reduced the oil content, and both medium and severe damage increased the free fatty acid content of the oil. The total losses in weight of kernels were 34·5, 15·6 and 9·9 per cent. for three experimental lots, respectively, the losses in edible oil were 41, 19·3 and 11·2 per cent., and the germination percentages were 42, 63 and 90.

To determine the reduction in viability of sorghum seed and the period at which it takes place, groups of four adults were confined in bags on sorghum plants at intervals of four days from the completion of pollination until the plant had passed maturity, which was reached about 130 days after sowing. Most of the insects in the bags died in 7–10 days without reproducing. When the seed was germinated after harvest, the germination percentages were 55·1, 33·8 and 31·8 for seed from plants that had been infested 91–110, 111–130 and 131–150 days after sowing, respectively. It is concluded that the reduction in viability is greatest when almost mature or mature plants are attacked. The damaged seeds were small and light as a result of the injury and subsequent infestation by fungi, and it was found possible to remove 32·6 per cent. of them by winnowing. The amount of damage varied with the variety of sorghum, varieties with the seeds largely enclosed by the glumes and those that matured quickly showing least injury.

In the field, *C. dregii* showed marked resistance to the commoner insecticides. In laboratory tests, it was more susceptible to those of plant origin, pyrethrum powder giving 75 per cent. mortality as compared with 70 for an emulsion spray containing 0·05 per cent. parathion and 70, 60 and 5 for dusts of 5 per cent. DDT, 0·65 per cent. BHC and 5 per cent. aldrin, respectively.

Swaine (G.) & Wyatt (C. A.). **Observations on the Sorghum Shoot Fly.** —*E. Afr. agric. J.* **20** no. 1 pp. 45–48, 2 figs., 1 ref. Nairobi, 1954.

Atherigona indica Mall. infests sorghum throughout Tanganyika, the damage being heaviest in the drier areas and on crops planted late or out of the normal season. Observations on the bionomics of this Anthomyiid showed that the females oviposit on the plants from about seven days after germination until the heads are formed, the eggs being laid singly on the lower surfaces of the leaves. The larvae hatch in two days and pass down between the outer leaves and the inner furled leaves, through which they bore into the young growing tissues. As a result, the heart rots and the central furled leaves become dry and yellow. Infested plants produce side-tillers, which may also be attacked, and the formation of a main leader shoot is thus often prevented. Pupation occurs in the soil or in the base of the stem. In the laboratory, the egg, larval and pupal stages lasted 2, 8 and 6·8 days, respectively, at 81°F., and in the field 17 days elapsed between peaks in oviposition, thus indicating a similar duration of development.

Sorghum is also liable to infestation by the stem borers, *Busseola fusca* (Fuller) and *Chilotraea* (*Proceras*) *argyrolepia* (Hmps.), which do not generally oviposit until the plants are about 2–3 weeks old, the larvae hatching five and nine days later, respectively. Measures were therefore tested for control of both *Atherigona* and stem borers, DDT being included against the latter. In a preliminary test, inconclusive results were given by five weekly applications of a dust of 2·5 per cent. DDT and 5 per cent. toxaphene in diatomite at 10 oz. per 1,000 plants on short-term sorghum infested by *Atherigona* and *Chilotraea*, beginning when the plants were 22 days old, although large increases in the numbers of headed plants were obtained. In a second test, in which five applications at the same rate were begun when the plants were only nine days old, on plots comprising 864 hills of two plants each, the numbers of hills showing dead hearts caused by *Atherigona* counted 40 days after germination were 340 for 2·5 per cent. DDT alone and 155, 170 and 196 for 2·5 per cent. DDT in combination with 1·5 per cent. γ BHC, 5 per cent. toxaphene and 2·5 per cent. aldrin, respectively, as compared with 469 for no treatment. There were no real differences in yield. Counts of the eggs indicated that the adults were not repelled by the treatments. Dusting with BHC was observed to cause withering and drying of the leaf tips, but had no ultimate adverse effects. It is concluded that control is obtainable by weekly applications of insecticide, that the BHC dust was the most promising, and that an early first application is advisable to allow the formation of a strong leader shoot.

Stephenson (P. R.). **Report of the Desert Locust Survey and Control, 1st October, 1950–31st December, 1952.**—[1 +] 64 pp., 4 pls., 2 fldg. maps in pocket. Nairobi, E. Afr. High Comm., 1953.

This report of the work carried out by the Desert Locust Survey and the Desert Locust Control Organisation against *Schistocerca gregaria* (Forsk.) in eastern and northern Africa and the Middle East in 1950–52 [*cf. R.A.E.*, A **40** 24] contains accounts of the development of the Control Organisation [**40** 25], the course of the outbreaks and the organisation of control, which was chiefly by means of BHC applied in bran baits [*cf.* **40** 133] and dusts against the hoppers, international cooperation in coordinating control, and research on possible breeding areas, locust movements and behaviour and the control of swarms by sprays applied from aircraft.

At the beginning of the period, danger threatened from the Somali peninsula, the Sudan, and India and Pakistan. Swarms migrating southwards from the Somali peninsula [*cf.* **36** 123] during October–December 1950 oviposited mainly in Somalia and not at all in Kenya or Uganda. Control measures against the resultant hoppers prevented the formation of large swarms, and though there was light, scattered breeding in Tanganyika and Kenya during February–May 1951, all gregarious locusts were destroyed by July. Swarms from the Sudan, where breeding was on an unexpectedly large scale and control was not complete, bred, though not extensively, in the Chad Territory, French Niger Colony and Mauretania [*cf.* **40** 321, etc.] in October–December 1950 and subsequently in Tripolitania [*cf.* **36** 206], where the hoppers were eradicated by the end of May 1951. As a result of these campaigns and considerable natural mortality, North Africa remained virtually free from infestation until the end of the period. Swarms from India and Pakistan entered Persia and Arabia in October–December 1950, and bred in Persia on an unprecedented scale during the first half of 1951 [*cf.* **43** 293]. Control measures resulted in an improvement that persisted until early in 1952, and they were also successful in Saudi Arabia, where the locusts bred chiefly in the centre and north, and in the Abyan irrigation area

in the Aden Protectorate, where infestation was heavy in November–December 1950 and subsequently recurred. In February 1951, serious breeding by locusts of unknown origin occurred on a front of some 1,000 miles along the southern fringe of the Arabian desert. Effective control was possible only in one area on the border of the Yemen and the Aden Protectorate, and here a BHC dust destroyed the hoppers, but not fledgling swarms, even at a concentration of 6·5 per cent. γ BHC, though dry BHC baits gave 40–50 per cent. mortality. Crop losses amounted to 10–30 per cent. in the Wadi Hadhramaut, and damage was also severe in the Yemen. In July, young swarms appeared in the Aden Protectorate, where dusts of 2·6 and 6·5 per cent. γ BHC gave 50 per cent. mortality of pairing locusts, and also in the Yemen, northern Ethiopia, Eritrea and the Sudan, but breeding was nowhere extensive. Most of the swarms entered British and French Somaliland and the Ogaden district of Ethiopia and migrated to Kenya in late September; many of the locusts were near the end of their life when they arrived, and breeding, though heavy, was confined to a small area where a baiting campaign against the hoppers was satisfactorily concluded in early January 1952.

Breeding in Ogaden and the south of British Somaliland was extremely heavy during November–December 1951, and owing to the wide dispersal of personnel, lack of communications, tribal opposition and difficulties imposed by the thick bush and heavy rains, many hopper bands escaped control. Numerous swarms were formed, but their migration into Kenya was halted by south-easterly winds in January 1952. Exceptionally vigorous depressions over the Persian Gulf caused a major northerly movement [*cf.* **36** 124; **39** 296] in mid-January 1952, and the locusts migrated into Ethiopia and also into the Yemen, Saudi Arabia, Jordan and Iraq, where the resulting hoppers were controlled or died out, Persia, where they bred widely in March and, despite control measures, again in May, Pakistan, where they bred in early April and there was a second invasion in June, and India, where serious monsoon breeding began in June–July. Campaigns against hoppers in Oman and Muscat during March–May were only partially successful owing to tribal opposition, and four medium-sized swarms left the area, but hoppers and fledgling swarms were completely controlled in western Aden with a dust of 14 per cent. DNC. During May–July 1952, swarms from the Ethiopian hills bred in British Somaliland and there was also heavy breeding in southern and eastern Ethiopia. Many of the hoppers were controlled, but some very large swarms developed and concentrated mainly in the west of British Somaliland and neighbouring districts of Ethiopia in July–August, where their breeding areas were successfully forecast and they were attacked with bait as they arrived. Large hopper bands appeared in October, but were almost completely destroyed by the end of the year, and only a few very small swarms reached Kenya, where the subsequent hoppers were easily controlled.

During October and early November 1952, immature swarms entered Aden and the Somali peninsula, apparently from the north-east; those that entered Aden bred in Saudi Arabia during January 1953.

Kovačević (Ž.). **Značaj poliedrije za masovnu pojavu nekih insekata.** [The Importance of Polyhedral Disease in the Mass Appearance of some Insects.]—*Plant Prot.* no. 23 pp. 3–20, 4 pls., 2 figs., 21 refs. Belgrade, 1954. (With a Summary in English.)

Lymantria dispar (L.) and *Malacosoma neustria* (L.) are common pests of oak forests and fruit trees in the valleys of the Sava and the Drava in Yugoslavia, and polyhedral virus disease plays an important part in the

natural control of the outbreaks that occur from time to time. The author reviews the literature on virus diseases of insects, with special reference to polyhedral diseases in Lepidoptera, and describes experiments in which *Bombyx mori* (L.) was reared in the laboratory for four years. Both univoltine and bivoltine strains were reared from the original material, and mortality from polyhedral disease occurred in each generation, the percentage ranging up to 97·2. Infection must have been latent in the survivors, and investigations were therefore carried out with *L. dispar*, on the assumption that latent infection occurs in it also. Egg-batches were collected in 1950 in a district in which an outbreak was declining and the disease was present, and the larvae were reared on the leaves of oaks (*Quercus*), hornbeam [*Carpinus*], beech, lime [*Tilia*], apple and plum in that and the three following years. Except in the first and last years, the larvae reached maturity only on the oaks, and even on these there was considerable mortality, which was probably due to the disease, and the reproductive potential was low. Analogous results were obtained in similar tests with *M. neustria* and *Hyphantria cunea* (Dru.). It is concluded that infection remains latent in a population until some unfavourable condition, such as food that is deficient in quality or quantity, or decreased vitality such as is associated with the later stages of insect outbreaks, permits it to become dominant.

Tanasijević (N.). **Dejstvo organskih preparata na štetne i korisne insekte lucerišta.** [The Action of organic Preparations on injurious and beneficial Insects in Fields of Lucerne.]—*Plant Prot.* no. 23 pp. 21–38, 15 refs. Belgrade, 1954. (With a Summary in English.)

A list is given of the insects observed attacking lucerne in Serbia and Macedonia in 1949–53, together with an account of investigations in 1952–53 on the effects of organic insecticides applied for their control. In the first year, dusts of 10 per cent. DDT (Pepein), 3 or 10 per cent. BHC (Bentox), a mixture of DDT and BHC (Multanin), and 1 per cent. parathion were applied at 18 lb. per acre to plots in a large field in which the untreated areas served as controls and as sources of reinfestation. Estimates of the insect population, obtained by sweeping, showed that the four insecticides reduced the total numbers of insects by 94, 76, 83 and 98 per cent., respectively, in 48 hours, as compared with the controls. Pepein retained its effectiveness for a fortnight, and the other materials for about a week. All the dusts were very effective against *Phytodecta fornicata* (Brüggem.) and parathion and Pepein gave 90–100 per cent. mortality of *Subcoccinella vigintiquatuorpunctata* (L.) and *Apion* spp. in 48 hours. Parathion gave complete kill of Aphids (*Macrosiphum pisum* (Harris) (*Acyrthosiphon pisi* (Kalt.)) and *Aphis craccivora* Koch), but was less effective against *Tychius flavicollis* Steph. and *Sitona* spp. The latter were destroyed by the Pepein dust, which, however, was less effective against the Aphids and *T. flavicollis*. Multanin gave complete kill of *Sitona* and *Apion*, but poor results against *Subcoccinella*, which was also completely unaffected by Bentox, though this dust was very toxic to the Aphids and to *Sitona* and *Apion*.

In the tests in 1953, two fields isolated from each other and their controls, and thus less liable to reinfestation, were sprayed with 0·06 per cent. parathion in an emulsion spray and 1 per cent. DDT, respectively, at 63 gals. per acre, and a third was dusted with 3 per cent. BHC at 18 lb. per acre. Reinfestation occurred much more slowly than in the previous experiment, and the DDT spray gave the best results, reducing the total insect population by 80–89 per cent. for over three weeks. Parathion gave comparable control for a fortnight, but then rapidly lost its effect, and the BHC

dust gave good control for a week, but did not prevent an increase in *S. vigintiquatuorpunctata* after that period.

Observations on beneficial insects in the two years showed that predacious Coccinellids were little or not at all affected by BHC dusts, whereas parathion was very toxic to them. Since it was not possible in the field completely to distinguish mortality due to the insecticides from that due to other causes (notably the great reduction in the Aphid population resulting from the treatments), the effect of dusts and sprays was investigated in the laboratory with *Coccinella septempunctata* L. as the test insect. The results showed that the dust of 10 per cent. BHC and sprays of 0·15 per cent. BHC or DDT were harmless, sprays of 0·2 per cent. BHC caused 20 per cent. mortality in one test and none in another, 5–10 per cent. DDT dusts caused 5 per cent. mortality, sprays of 0·2 per cent. DDT caused 20 per cent. mortality, and a 0·5 per cent. DDT spray, a spray of 0·015 per cent. parathion and a dust of 1 per cent. parathion caused complete kill in a very short time.

Tominić (A.). **Ispitivanja muhe trešnjarice u Dalmaciji.** [Investigations on the Cherry Fruit-fly in Dalmatia.]—*Plant Prot.* no. 23 pp. 44–62, 1 pl., 9 refs. Belgrade, 1954. (With a Summary in English.)

Rhagoletis cerasi (L.) is a serious pest of cherries in some districts on the Dalmatian coast of Yugoslavia. During observations on its bionomics in 1952–53, the first adults appeared in the second half of April and emergence continued until some time in May. Females predominated in the first half of the flight period, which continued until mid-June, and males in the second half. The flies fed at first on the leaf sap of different plants and then on the juice of the cherries, which they repeatedly punctured. Migration into and out of the orchards was continuous, and the most favourable conditions were afforded by trees with dense crowns that gave protection from the sun and wind. Observations on the abundance of the adults on different parts of the crown are recorded. Infestation of the fruits usually began with the second half of May and rapidly increased towards the end of May. In cages, the females lived for maxima of 15–32 days and averages of 6–8. Oviposition began 6–10 days after emergence and lasted 6–9 days, the numbers of eggs laid per female ranging from 5 to 71. Eggs were mostly laid in the ripening cherries, and they hatched in 7–8 days at 22–25°C. [68–77°F.]. In nature, the larval stage lasted about 20 days, the first larvae abandoning the fruits about 20th June and the last at the beginning of July. Pupation occurred at depths of 1–2 ins. in the soil. Pupal mortality did not exceed 3 per cent. under normal conditions, but reached 15 per cent. in very dry soil. Some 1·5 per cent. of the pupae required two years to complete their development.

A solution of 2 per cent. ammonium stearate was much the best of several attractants for the adults tested in open-mouthed jars suspended in the trees. Its effectiveness was maintained for at least 22 days and did not decrease when the liquid was diluted by frequent rains. The greatest numbers of flies were caught in the middle and upper part of the crown, and the catch increased directly with the diameter of the mouth of the jar.

In experiments on control, adults several days old were caged for 1–30 minutes with dried spray deposits of various insecticides. The best results were given by two proprietary parathion preparations, which gave complete mortality at suitable concentrations after exposures of only 1–2 minutes. They remained effective for only 2–3 days, however. A proprietary preparation of DDT in oil killed all the flies in one day after contact for 2–5 minutes and retained its effectiveness for nine days, though longer periods of contact

were then necessary. A 10 per cent. DDT dust was also effective and did not lose its toxicity for over ten days.

In field tests on maraschino cherries, the best protection was afforded by the preparation of DDT in oil applied as a mist spray twice at an interval of five days. A mist of 0·4 per cent. DDT from another preparation applied twice at an interval of eight days also gave very good results, but a parathion spray applied three times at intervals of 8 and 15 days appeared to attract the flies, many more being taken in trap-jars on the sprayed trees than on the untreated ones. Nevertheless the percentage infestation on the former was eventually only half or one-third of that on the untreated trees, indicating that parathion killed great numbers of the flies before they had time to oviposit.

Bebić (N.). **Prilog poznavanju biologije rutave bube.** [A Contribution to Knowledge of *Epicometis hirta*.]—*Plant Prot.* no. 23 pp. 63–71, 1 pl., 6 refs. Belgrade, 1954. (With a Summary in English.)

Epicometis (*Tropinota*) *hirta* (Poda), which has recently become widespread in Serbia, caused considerable damage to the blossoms of fruit trees and vines in 1951–53. All stages of this Cetoniid are described, and an account is given of observations on its bionomics, which were similar to those recorded from Rumania and Austria [*cf. R.A.E.*, A **24** 677; **40** 132].

There was only one generation a year, the adults hibernating in the pupal cells and appearing in early April at a mean air temperature of 15°C. [59°F.] and a soil temperature of 13°C. [55·4°F.] at a depth of 4 ins. They were active on warm days and sought flowers turned towards the sun, but hid in the soil at other times. A list is given of 37 wild and cultivated plants on which the beetles were observed to feed; they attacked not only the stamens and pistils but also the petals. Pairing began 3–4 days after emergence from the soil, and oviposition occurred 6–8 days later, reaching a peak at the end of May. Most of the eggs were found in mole-hills and loose soil. In the laboratory, oviposition was most intense at temperatures of 20–23°C. [68–73·4°F.], the females laying an average total of 30 eggs each, and decreased at higher temperatures. The eggs hatched in six days at 31°C. and in 19 days at 20°C., but no hatching occurred at lower temperatures. The larval stage lasted 53–57 days at a mean temperature of 23°C. The larvae fed on plant rootlets and humus and were not injurious, preferring moderately damp soil. They constructed earthen cells in the first half of August at a mean temperature of 22°C. [71·6°F.], and the prepupal and pupal stages together lasted 19–23 days.

In laboratory tests, sprays of parathion and DDT from proprietary preparations were effective against the adults, but were also toxic to bees, even at low concentrations, so that their application in the field would be undesirable.

Servadei (A.). **Il *Brachycerus albidentatus* Gyll. (Col. Curculionidae) in Sardegna.** [*B. albidentatus* in Sardinia.]—*Studi sassaresi* Sez. III *Ann. Fac. Agr. Sassari* **1** pp. 1–20, 1 pl., 14 figs., 10 refs. Sassari, 1953.

The author describes the newly hatched and full-fed larva of *Brachycerus albidentatus* Gylh. and gives an account of observations on its bionomics in Sardinia, where the larvae of this weevil sometimes cause considerable damage to the bulbs of garlic and the adults feed on the leaves, often killing

young plants. The first adults appeared in October, but did not feed and subsequently re-entered the soil or sheltered in cracks. Feeding began in mid-January, the leaves of cultivated garlic or, in the absence of this, closely related wild plants being attacked, but the majority of the beetles did not become active until early March. Pairing was observed until the end of March, and eggs were laid in the second half of the month. They were inserted into the bulb or laid on the stem or in the soil near the plants. The larvae hatched in about a week and fed in the bulbs, destroying 3–4 cloves in each. Only one larva was found per plant. Full-fed larvae were present towards the end of June, and they constructed cells in the soil, in which they pupated about 20 days later. The pupal stage lasted about a month, and the first formed adults were observed from the end of July. In dry soil, the adults remained in the pupal cells until the first rains, but they came to the surface at once in damp soil. Only mechanical methods of control are practicable, and straight-sided trenches with containers sunk into them at intervals of 2–3 yards should be dug round garlic crops to trap the adults as they move towards the plants.

Martelli (M.). **Corologia sarda di due Lepidotteri endofiti nel granoturco (*Zea mays* L.).** [The Distribution in Sardinia of two Lepidopterous Pests of Maize.]—*Studi sassaresi* Sez. III *Ann. Fac. Agr. Sassari* **1** pp. 179–184, 2 figs., 1 map, 6 refs. Sassari, 1953.

On the basis of investigations in 1951–52, a map is given showing the distribution and abundance of *Pyrausta nubilalis* (Hb.) and *Sesamia cretica* (Led.) on maize and sorghum in Sardinia. *P. nubilalis* is the more numerous in the centre and north and is found mostly in hilly districts, but it is not present in the extreme south. *S. cretica* is present throughout the island but is most abundant in the south; it is generally found in the plains and low-lying districts. In some years, adult emergence of *S. cretica* begins before 15th April, the date by which infested plants and plant parts must by law be destroyed. In 1953, adults were obtained on 8th April from field-collected material, and further investigations are urged to determine whether a revision of the official date is necessary.

Bellod y Bellod (M.). **Nuevo método de lucha contra el arañuelo del olivo (*Liothrips oleae* Costa).** [A new Method of Control of *L. oleae*.] —*Bol. Pat. veg. Ent. agric.* **20** (1953–54) pp. 1–33, 7 figs., 5 graphs, 10 fldg. tables. Madrid [1955].

Liothrips oleae (Costa), which is a serious pest of olive in Spain, is usually controlled by tent fumigation with hydrogen cyanide [*cf. R.A.E.*, A **15** 418]. However, in view of difficulties in obtaining the necessary chemicals and the high cost of application, large-scale experiments were carried out in 1952–53 in the Province of Jaén, where infestation is particularly severe, on the effectiveness of sprays and dusts of organic insecticides. In both years, the degree of infestation was first determined by fumigating sample trees with HCN and counting the thrips that fell or were jarred on to sheets spread beneath the trees. In 1952, the percentage mortality among these averaged 99·43. The dusts were applied when the temperature was at least 15°C. [59°F.] and the sprays at 8–24°C. [46·4–75·2°F.], and sheets were again spread beneath sample trees and counts made of the dead and living insects that fell on to them. When no more insects fell, these

trees were fumigated with HCN, and the insects obtained after jarring were considered to be the survivors from the previous treatment.

In 1952, sprays were applied between 23rd March and 24th April, somewhat later than was desirable as a few eggs were already present and were unlikely to be controlled by the treatments. Operations were hindered by rain, but the mortality percentages obtained were 99·05 and 99·3 for 0·1 and 0·15 per cent. DDT, respectively, prepared from a 20 per cent. emulsion concentrate, 98·98 and 98·92 for 0·05 and 0·1 per cent. DDT prepared from a 10 per cent. emulsion concentrate, 89·14 and 94·45 for 0·5 and 0·75 per cent., respectively, of an emulsion product containing 40 per cent. chlorinated terpenes, and 94·06 for a suspension spray containing 0·024 per cent. lindane [almost pure γ BHC]. Counts in December showed that all treatments had proved effective and that those with 0·1 per cent. DDT had reduced the initial infestation by 91·88 per cent. Damage by the thrips was only slight, though neighbouring untreated groves were severely attacked.

In 1953, dusts and sprays were applied in the first half of March, before any eggs were laid. The mortality percentages obtained with the dusts were 12·8 for 75 per cent. cryolite, 99·54 for 5 per cent. DDT, 96·05 for 8 per cent. BHC, 95·4 for 0·6 per cent. lindane and 94·29 and 89·5 for 10 per cent. chlorinated terpenes alone and with 40 per cent. sulphur, respectively, and those obtained with the sprays, all of which were in emulsion form, were 76·02 for 0·03 per cent. lindane, 96·48 for 0·021 per cent. parathion, 97·82 for 0·05 per cent. dieldrin and 98·71 for 0·1 per cent. DDT.

In view of these results, an emulsion spray of 0·1 per cent. DDT or a dust of 5 per cent. DDT are recommended and are shown to reduce the cost of treatment by over 20 and 50 per cent., respectively, as compared with fumigation. They should be applied in October–March, when no eggs are present, after the olives have been picked (to avoid contamination) and before pruning.

DEL RIVERO (J. M.). **Algunas experiencias para combatir la pulguilla de la remolacha (*Chaetocnema tibialis* Illig.) por medio de insecticidas pulverulentos.** [Some Experiments on the Control of the Beet Flea-beetle, *C. tibialis*, with insecticidal Dusts.]—*Bol. Pat. veg. Ent. agric.* **20** (1953–54) pp. 71–79, 1 graph, 15 refs. Madrid [1955].

Experiments with dusts for the control of the beet flea-beetle, *Chaetocnema tibialis* (Ill.), were carried out in the laboratory in 1950, leaves of beet being dusted and placed with their petioles in water in cages into which ten adults were introduced. Complete mortality was given in 24 hours by 10 per cent. crude BHC, 0·6 per cent. lindane [almost pure γ BHC], and 3 per cent. nicotine, in 24–72 hours by 6 per cent. DDT, and in 48–72 hours by 50 and 35 per cent. synthetic cryolite and 50 per cent. barium fluosilicate. A dust of 50 per cent. natural cryolite gave only 50–80 per cent. mortality in 72 hours. When the two synthetic cryolite products were compared in a special test in which about half the bottom of each cage was covered with the dust, complete mortality was given in 24 and 72 hours by the 50 and 35 per cent. products, respectively, as compared with 5 per cent. mortality in the control in 48 hours. When adults were introduced into a test tube that had been lightly dusted with the nicotine product, all died within one minute; those in one dusted with the lindane product all died in nine minutes. In a field test, a cryolite powder containing 50 per cent. sodium fluoaluminate freed severely attacked plants from infestation for more than eight days when liberally applied as a dust, but was ineffective at 0·5 per cent. in a spray. Dusts of nicotine, BHC, lindane, or DDT are recommended for control, BHC and lindane being preferable to nicotine

because, although their rapidity of action is about the same, they retain their effectiveness longer. DDT is comparatively slow in action and might with advantage be used with more rapidly toxic insecticides.

ALFARO (A.). **Aspecto fitopatológico del cultivo algodonero en Aragón.** [Phytopathological Aspect of Cotton-growing in Aragon.]—*Bol. Pat. veg. Ent. agric.* **20** (1953–54) pp. 145–166, 22 figs., 15 refs. Madrid [1955].

Cotton with a short vegetative cycle has been successfully grown under irrigation in recent years in the low-lying parts of Aragon, where summer temperatures are high and rainfall low, and also in parts of the neighbouring Provinces of Navarra and Logroño. A list is given showing the insects observed attacking the crop or stored cottonseed in 1946–54, together with notes on the distribution and importance of some of them, and diseases caused by fungi and bacteria are dealt with similarly.

Earias insulana (Boisd.), which is injurious in other cotton-growing areas of the country [*cf. R.A.E.*, A **36** 197] and is the only insect treated in any detail, was thought not to be of economic importance in Aragon, but damage by it was considerable in 1949–50 in the valleys of the Ebro and its tributaries, though only slight in 1951–53. In 1949, the attack developed late, indicating that only small numbers had survived the previous winter and that the population did not much increase until the autumn. In observations on larvae in field cages from 23rd September to 20th December, during which period the temperature fell only rarely below freezing-point, most of the larvae pupated in late September and the first half of October. Those that did so later had difficulty in constructing their cocoons. The pupal stage lasted 17–25 days for pupae that did not overwinter, and the last adult to emerge in the year did so on 18th November. No overwintered pupae gave rise to adults in the spring; parasites emerged from a few, but the majority were apparently killed by unfavourable climatic conditions. In 1950, the population was low in the field in spring, and damage was first observed in the second half of July, on cotton sown between 25th April and 25th May. The pupal stage lasted a week in July–August. Infestation was less severe in the Ebro valley, but about half the crop in the north-east of the area was destroyed by *Earias* and subsequent attack by fungi. The pupal stage lasted 20–60 days in the autumn of 1950, development continuing until mid-December, and it was apparently favoured by low relative humidity. In the laboratory, 15 and 10 adults emerged from lots of 50 pupae kept at 60–85 and 45–60 per cent. relative humidity, respectively. Only one adult emerged in spring from the pupae caged over winter in the field. It is concluded that few pupae survive the winter in this area, which appears to be about the northern limit for the development of the pest, and that infestation becomes severe only when conditions in spring are favourable for development.

DEL RIVERO (J. M.). **La roseta de los agrios.** [Injury to *Citrus* by *Empoasca.*]—*Bol. Pat. veg. Ent. agric.* **20** (1953–54) pp. 193–210, 7 figs., 16 refs. Madrid [1955].

Superficial yellowish lesions on oranges and mandarin oranges have been observed in eastern Spain for over 20 years, but have recently become more frequent. Similar injuries have been reported from Sicily [*cf. R.A.E.*, A **28** 328], where they have been found to be caused by *Empoasca decedens* Paoli, and Cicadellids of the same genus cause a spotting of orange fruits in

California [*cf.* **31** 102]. The lesions are described, and an account is given of investigations begun in the Province of Valencia in 1951. In that year, 25–50 per cent. of the fruits were affected in many orchards and up to 100 per cent. in some, especially on mandarin orange. Grapefruits and lemons were not affected. In 1952–53, large numbers of *E. decipiens* Paoli were observed in the orchards at the time the injuries were being produced, and examples taken in 1952 caused typical lesions on navel oranges in the laboratory. None was produced on mandarin oranges, so that other species of *Empoasca* may also be involved; no other was observed. *E. decipiens* is common on vines and cotton in Spain. Cotton is severely damaged by *E. lybica* (de Berg.), which was found in one area on both cotton and vines, but no evidence could be obtained that this also attacks *Citrus*.

Control measures should be applied when the lesions are first noticed and there is an appreciable increase in the number of *E. decipiens*, which migrates to oranges in autumn. Since the attack occurs over a period, materials that do not rapidly lose their effectiveness are advisable. In a test on mandarins in 1953, treatments were applied on 17th September, when the fruits were still green but *E. decipiens* was already present, and on 16th October. On 26th October, the percentages of fruits injured, as compared with 40 for no treatment, were 0 for a 5 per cent. DDT dust, 5·6 for 0·1 per cent. DDT in a wettable-powder spray, 31 for a spray containing 4 per cent. lime and 0·1 per cent. casein (which was applied on the first date only), 31·5 for 0·05 per cent. malathion on the first date and 0·016 per cent. lindane [almost pure γ BHC] on the second, and 46·7 and 48 for emulsion sprays of 0·07 per cent. parathion and 0·05 per cent. DDT, respectively. The lime wash, which was repellent and similar to one recommended in California [**31** 102], gave good results as long as the protective covering on the fruits remained intact, and may be advantageous where DDT is likely to provoke outbreaks of mites or Coccids through destruction of their natural enemies, though an acaricide might be added to it to prevent this. It did not protect the whole grove when applied merely to the trees on the periphery.

Domínguez García-Tejero (F.). **Escolítidos españoles de interés agrícola.** [Spanish Scolytids of agricultural Interest.]—*Bol. Pat. veg. Ent. agric.* **20** (1953–54) pp. 211–279, 29 figs., 26 refs. Madrid [1955].

The Scolytids dealt with in this paper are those that attack fruit trees, olive and elm in Spain. The morphology, habits and galleries of the family as a whole are described, keys are given to the various tribes and genera, with notes on the morphology of the species occurring in each, and the distribution, food-plants, bionomics and control of the more important are reviewed. Of the 16 species included, those that are of most importance as primary pests are *Scolytus rugulosus* (Ratz.) and *Xyleborus* (*Anisandrus*) *dispar* (F.) on fruit trees, and *Phloeotribus scarabaeoides* (Bernard) and *Hylesinus oleiperda* (F.) on olive. The control measures recommended against these include the destruction of infested material and the application of sprays of DDT or BHC against the adults.

Ruiz Castro (A.). **Una plaga del boj** (*Monarthropalpus buxi* **Lab.**). [A Pest of Box (*M. buxi*).]—*Bol. Pat. veg. Ent. agric.* **20** (1953–54) pp. 345–367, 18 figs., 21 refs. Madrid [1955].

Monarthropalpus buxi (Lab.) is a serious pest of box (*Buxus*) in parts of central Spain, and in this paper, which is based largely on the literature,

all stages of the Cecidomyiid and the damage caused by the larvae mining in the leaves are described, its distribution is reviewed, and its bionomics and control are discussed, mainly from work in the United States [*cf. R.A.E.*, A **11** 583; **19** 435; **29** 636; **35** 263]. In Madrid in 1952 and 1953, the first adults emerged on 9th and 19th April, respectively, and emergence continued for 2–3 weeks. The egg stage lasted 2–4 weeks, and young larvae were found in the second half of June. The larvae overwintered in the leaves and pupated at the end of March and the beginning of April, the pupal stage lasting 2–3 weeks, though adults did not emerge until mid-May from material from Zamora. A spray of 0·125 per cent. DDT gave excellent control; it should be applied just before the adults emerge.

Gómez-Menor Ortega (J.). **Tíngidos que viven sobre el peral.** [Tingids that live on Pear.]—*Bol. Pat. veg. Ent. agric.* **20** (1953–54) pp. 369–392, 8 figs., 30 refs. Madrid [1955].

Two Tingids, *Stephanitis pyri* (F.) and *Monosteira unicostata* (Muls. & Rey), attack pear in Spain, and a third, *Physatocheila confinis* Horv., does so in other Mediterranean countries (Turkey and Greece) but has not so far been recorded from Spain, though it probably occurs there. In order to facilitate recognition of these three, the author gives keys and descriptions differentiating them from closely related species, with notes on distribution and food-plants.

Alfaro (A.). **Algunas observaciones sobre la biología y tratamiento de *Cydia pomonella* (L.) en 1953.** [Some Observations on the Biology and Control of *C. pomonella* in 1953.]—*Bol. Pat. veg. Ent. agric.* **20** (1953–54) pp. 393–407, 3 graphs, 1 ref. Madrid [1955].

In order to improve control of *Cydia pomonella* (L.) on apple near Saragossa in 1953, the seasonal development of the moth was followed by records of emergence in outdoor cages, the use of baits to trap the adults, and counts of the larvae that entered trap-bands on the trunks to pupate. Adult emergence began on 5th May and reached a peak in the second half of the month, and emergence of the first-generation adults occurred from mid-July to mid-August. The two sexes were about equally numerous. The addition of 0·1 per cent. of a saturated alcohol solution of geraniol crystals increased the attractiveness of baits of 8–10 per cent. molasses, and open pots were superior to trap-glasses of the type used against Trypetids. The numbers of moths caught in the standard traps evolved are shown on a graph and related to weather conditions. More females were caught than males. Heavy rain in June limited oviposition and hatching, and infestation was somewhat less severe than usual. Maximum numbers of larvae were taken in the trap-bands at the end of July and the beginning of August.

The experiments on control were carried out on the trees used for the population studies, which had reduced the populations somewhat. In the first test, sprays were applied on 25th May, about a month after petal fall, when there were signs of attack by the larvae, and on 11th and 25th June and 6th August, the first three applications being directed against the first generation and the fourth against the second. The apples were picked on 9th September and the percentages attacked, as compared with 33–37 per cent. for no treatment, were 6 for 0·5 per cent. lead arsenate, 2 for the same with 0·5 or 1 per cent. white oil, 10 and 4 for 0·25 per cent. wettable DDT alone or with 1 per cent. white oil, respectively, 10 for 1 per cent. of

a product containing 3·85 per cent. DDT and 1·5 per cent. lindane [almost pure γ BHC] in white oil, 19 for 0·08 per cent. of an emulsion concentrate containing 35 per cent. parathion, and 35 and 33 for 0·5 per cent. of emulsion concentrates containing 23 per cent. aldrin and 16 per cent. dieldrin, respectively. Severe infestation by *Bryobia praetiosa* Koch developed on the tree sprayed with wettable DDT.

In the second test, sprays were applied on 26th May (about 3½ weeks after petal fall, when infestation was just beginning), 12th and 30th June and 21st July, all against the first generation. The apples were picked on 14th September, and the percentages attacked (including those that had fallen just before 8th September) as compared with 58 for no treatment, were 12 and 2 for 0·5 and 1 per cent. lead arsenate, respectively, 5 and 1, respectively, for the same with the addition of 0·5 per cent. white oil, 4 for 0·5 per cent. lead arsenate with 1 per cent. oil or 1 per cent. lead arsenate with 0·25 per cent. oil, 5 for 0·25 per cent. wettable DDT, and 10 and 9 for a mixture of 0·125 per cent. wettable DDT and 0·25 per cent. lead arsenate, alone or with 0·25 per cent. white oil, respectively. The lead arsenate usually caused some scorching of the leaves when applied alone or with white oil, owing probably to the quantity of liquid applied, high summer temperatures and drought in July. Treatment with wettable DDT alone resulted in severe damage by *B. praetiosa* and an unidentified mite.

DEL CAÑIZO (J.). **Invasión de langosta peregrina en Canarias (Octubre de 1954).** [An Invasion by *Schistocerca gregaria* of the Canary Islands (October 1954).]—*Bol. Pat. veg. Ent. agric.* **20** (1953–54) pp. 409–431, 15 figs., 2 refs. Madrid [1955].

Large swarms of *Schistocerca gregaria* (Forsk.) from Africa invaded the Canary Islands, mainly Gran Canaria and Tenerife, in mid-October 1954, and others were washed up alive on the southern and eastern coasts, and as crops were threatened, a campaign of control was begun a week later. Baits consisting of 6 per cent. of a 25 per cent. BHC powder and 94 per cent. bran, moistened with water, were distributed at 63 lb. per acre, mostly in Gran Canaria, and light aeroplanes were used to apply the BHC product as a dust at 22·5 lb. per acre to resting swarms in the early morning. Supplementary measures included the use of sprays and dusts from ground machines and the burning of shrubby vegetation on which the locusts settled. All the swarms were exterminated by the beginning of December. They had consisted of young adults, and the only place where oviposition occurred was the small island of Hierro. The eggs hatched in January and February, and the hoppers were rapidly destroyed with the BHC baits and sprays. As a result of the campaign, the damage caused was much less than anticipated.

GEERING (Q. A.). **A Method for controlled Breeding of Cotton Stainers, *Dysdercus* spp. (Pyrrhocoridae).**—*Bull. ent. Res.* **46** pt. 4 pp. 743–746, 1 fig., 1 ref. London, 1956.

In the method described, which is that used for the large-scale breeding of *Dysdercus* spp. in Uganda, second-instar nymphs are introduced in batches of 150 into cages consisting of a shallow tin cylinder with detachable cotton cloth top and bottom, resting on chicken wire stretched on a wooden frame, and provided daily with fresh cottonseed soaked in water. When adult, the females oviposit on the cloth floor. The eggs are removed each day and they and the resulting first-instar nymphs, which do not feed, are kept on

moist filter paper in small glass dishes until the second instar is reached. The advantages of the cage unit are outlined, with particular reference to control of disease and to the other hazards of large-scale breeding.

Benson (R. B.). **Another new Sawfly (Hym., Tenthredinidae) on Larch in Britain.**—*Ent. mon. Mag.* **90** pp. 113–114, 5 figs., 2 refs. London, 1954.

Kirkland (R. C.) & Styles (J. H.). **Notes on** *Pristiphora glauca* **Benson.** —*Bull. ent. Res.* **46** pt. 4 pp. 749–752, 1 fig., 1 ref. London, 1956.

In the first paper, descriptions are given of the adults of both sexes of *Pristiphora glauca*, sp.n., larvae of which were found feeding on Japanese larch (*Larix leptolepis* (*kaempferi*)) and European larch (*L. decidua*) in England, together with characters distinguishing them from the adults of the very similar *P. wesmaeli* (Tischb.), which feeds on the same trees. One specimen of *P. glauca* was found in Switzerland, but none occurred among specimens of *P. wesmaeli* from Finland.

In the second paper, the eggs of *P. glauca* and the larvae in each of the five instars are described, and an account is given of observations on its bionomics in the field and laboratory. These showed that the adults are present from the end of March until early May, peak emergence occurring in mid-April. The eggs are placed singly in slits cut in needles of young flushing larch shoots. The egg and larval stages last 14–21 and 28–35 days, respectively, and the larvae pupate in cocoons in the forest litter. There is one generation a year. The larvae closely resemble those of *P. wesmaeli*, but whereas larvae of the latter in all instars are still abundant in the third week of August, those of *P. glauca* usually complete their development by mid-June. The larvae of both feed mainly on the new foliage within about ten feet of the ground, destroying the needles from the tip of the shoot backwards and sometimes attacking the dwarf shoots, but *P. wesmaeli* is more frequent on the juvenile shoots and *P. glauca* on the less vigorous new shoots of the lateral branches of older trees. The latter species causes no serious damage and does not affect the winter buds. Its complete distribution in Britain is not known, but it is not widespread and larvae were most abundant in Shropshire and Radnorshire; a few were collected in Surrey, Hampshire and Norfolk.

Morison (G. D.), Jeffree (E. P.), Murray (L.) & Allen (M. D.). **Acarine and** *Nosema* **Diseases of Honeybees in Britain, 1925–47.**—*Bull. ent. Res.* **46** pt. 4 pp. 753–759, 3 graphs, 9 refs. London, 1956.

The following is almost entirely the authors' summary. Between 1925 and 1947, 9,929 samples of bees from Great Britain were examined for infestation by *Acarapis woodi* (Rennie) and infection by *Nosema apis*. There was a significantly lower incidence of *A. woodi* in English samples than in Scottish ones, but a somewhat higher incidence of *Nosema* in England than in Scotland was not significant. A decrease in the incidence of *A. woodi* over the 22 years was highly significant in both England and Scotland, although the rate of decrease was not significantly different between the two countries. The average incidence of *A. woodi* during each month of the year was at its lowest in April, May and June, while infection by *Nosema* reached its maximum in these three months and fell to a minimum in the autumn. Data on the seasonal incidence of *Nosema* in an apiary in Scotland between 1948 and 1953 show a similar distribution to that for England and

Scotland combined. Results for the incidence of both *A. woodi* and *Nosema* throughout the year are compared with those of other authors, and possible reasons for the seasonal fluctuations are discussed.

HOWE (R. W.) & BURGES (H. D.). *Trogoderma afrum* **Priesner, a Synonym of** *T. granarium* **Everts and a Comparison with** *T. versicolor* **(Creutz.).** —*Bull. ent. Res.* **46** pt. 4 pp. 773–780, 7 figs., 15 refs. London, 1956.

Trogoderma granarium Everts has been recorded as causing damage to stored cereals in India, Cyprus, Egypt, the Sudan and Nigeria, was recently discovered in California [*cf. R.A.E.*, A **42** 333], and attacks dry malt stored in warm malt bins in Britain [*cf.* next abstract] and other parts of Europe. *T. versicolor* (Creutz.) has been recorded from stored grain in some areas in which *T. granarium* occurs, including India, Cyprus, Egypt, Britain, other parts of Europe and California, but mainly attacks produce of animal origin. These two species of *Trogoderma* are those most frequently recorded from stored products in Britain, but the adults are difficult to separate by means of external characters, and it appears likely that *T. granarium* has at times been misidentified as *T. versicolor*. In addition, *T. afrum* Priesner, which was recently described from Egypt and the Sudan [*cf.* **41** 413], greatly resembles *T. granarium*. Morphological studies were accordingly made of these three species, for which the material employed comprised cultures of *T. granarium* and *T. versicolor* that had been bred in the laboratory for many years, specimens of *T. granarium* collected from British maltings and from groundnuts in Nigeria and of *T. granarium* received from India, and living examples, received from Egypt, of the species of *Trogoderma* common in that country. In addition, cross-breeding experiments were carried out with adults reared from pupae of the Egyptian *T. afrum*, of *T. versicolor* from the laboratory cultures, and of *T. granarium* from cultures and maltings.

T. granarium and *T. versicolor* were found to be morphologically distinct, and characters differentiating them are described; they did not interbreed, and attempts to cross *T. versicolor* with *T. afrum* were also unsuccessful. *T. granarium* and *T. afrum* interbred, however, and gave rise to fertile offspring, and since they were found to be morphologically almost identical, they are considered to be almost certainly conspecific. The question can only be settled by dissection of the type specimens.

The authors state that they use the name *T. versicolor* for the species to which it is usually applied by workers in Britain [and America, who consider *T. inclusum* Lec. a synonym of it]. They understand, however, from J. Balfour-Browne that this species is *T. inclusum* and that *T. versicolor* is a different species known by that name in eastern Europe. The matter cannot be decided by examination of the type of *T. versicolor*, because it has been destroyed.

HADAWAY (A. B.). **The Biology of the Dermestid Beetles,** *Trogoderma granarium* **Everts and** *Trogoderma versicolor* **(Creutz.).**—*Bull. ent. Res.* **46** pt. 4 pp. 781–796, 7 figs., 20 refs. London, 1956.

In Britain, *Trogoderma granarium* Everts and *T. versicolor* (Creutz.), all stages of which are described, are serious pests only in maltings [*cf.* preceding abstract]. The larvae feed on the germ and endosperm of the malt grain and frequently leave only the husk; when feeding on wheat grains, however, they often eat only the germ and bran. The spread of infestation is facilitated by the hairiness of the larvae, which enables them

to cling to sacking and clothing and also, possibly, to rats and mice. Malt is frequently stored for as long as a year in wooden bins in which the temperature ranges from 24 to 26°C. [75·2 to 78·8°F.] and the relative humidity from 25 to 35 per cent.; in modern maltings, storage is often at air temperature in bins lined with steel or concrete. The effect of temperature and humidity on the development of the two species was investigated in the laboratory at temperatures of 15–40°C. [59–104°F.] and relative humidities of 2, 25, 50 and 73 per cent., the food being brewers' malt, and the following is largely based on the author's summary of the results.

The optimum temperatures for development were found to be 30–35°C. [86–95°F.], when the life-cycle from egg to adult can be completed in 24 days by *T. granarium* and in 30 by *T. versicolor*. Development was much slower at lower temperatures, and no larvae of *T. granarium* pupated, even after 12 months, at 20°C. [68°F.]. The use of cool storage would thus be a possible method of control. The duration of the egg and pupal stages was unaffected by changes in relative humidity, but the higher humidities were more favourable than the lower for the development of the larvae. The higher moisture content of the food under the more humid conditions is probably of greater importance than actual air humidity. Under optimum conditions, females of *T. granarium* laid 30–50 eggs each, and those of *T. versicolor* 100–120. The numbers laid by *T. granarium* varied little between 25°C. [77°F.] and 40°C., but those laid by *T. versicolor* reached a maximum at 30°C. and were low at 40°C. *T. versicolor* did not oviposit at 15°C. or *T. granarium* at 20°C., and *T. versicolor* also failed to oviposit at 40 and 20°C. in combination with the lowest humidity; in general, the higher humidities were the more favourable.

In tests of the nutritional requirements of *T. versicolor*, the larvae developed well on wheat and malt with a moisture content of 12–13 per cent. but slightly more slowly on maize. They did not thrive on dried milk with a moisture content of 6 per cent., fishmeal (11 per cent.) or ground rice (12–13 per cent.). Tests with various modifications of an artificial diet [*R.A.E.*, A **32** 81] showed that carbohydrate is not essential for normal development, nor is cholesterol if yeast is present as a source of other sterols; the controlling factor appears to be a sufficiency of B vitamins.

DAVEY (J. T.). **A Method of marking isolated Adult Locusts in large Numbers as an Aid to the Study of their seasonal Migrations.**—*Bull. ent. Res.* **46** pt. 4 pp. 797–802, 5 refs. London, 1956.

The following is largely the author's summary. A method of marking adult locusts, particularly useful when numbers are low and hand marking would be difficult, is described. It involves the use of a small hand spray-gun from which a jet of paint can be directed at the locusts in spurts at ranges up to about 15 ft. The paints tested consisted of suspensions of pigments in light oil. They showed little toxicity to *Schistocerca gregaria* (Forsk.) or *Locusta migratoria migratorioides* (R. & F.) in laboratory tests, except when diluted in kerosene, and the marks remained visible for several weeks. In field tests, the numbers of locusts marked in an hour by means of the gun and caught and marked by one labourer by hand were 72 and 5–6, respectively, where adult locust density was 15 per 100 paces, and the corresponding figures for a place where it was 7–8 per 100 paces were 60 and 17; at higher densities (50–100 per 100 paces), either method can be used. The efficiency of the spray-gun is reduced by high winds and dense vegetation, and it is more costly than hand marking. Most of the marked locusts cannot be distinguished without being captured.

Some results obtained with this method during investigations on suspected seasonal movements of solitary individuals of *L. m. migratorioides* in the French Sudan are given. In two months, over 50,000 locusts were marked with a red paint; four were recovered some 37 or more miles from the area in which they were marked, and the paint was still clearly visible after five weeks. Ways in which the technique could be improved, including the possibility of using fluorescent paints, are discussed.

GRUNBERG (A.), POLAC'EK (K.) & PELEG (J.). **Fumigation Trials with Ethylene Dibromide for the Control of Eggs and Larvae of** *Ceratitis capitata* **(Wied.) in** *Citrus* **Fruit.**—*Bull. ent. Res.* **46** pt. 4 pp. 803–811, 5 refs. London, 1956.

The following is almost entirely based on the authors' summary of the experiments described, which were carried out in Israel in 1951–53. At about 20°C. [68°F.], fumigation for 2½ hours with ethylene dibromide did not injure Jaffa and Valencia oranges when the concentration was 18 oz. per 1,000 cu. ft. or grapefruit when it was 15 oz., but the maximum concentration tolerated by Jaffa oranges when the exposure was prolonged to six hours was 8 oz. per 1,000 cu. ft. Exposure for 2½ hours to 15 oz. per 1,000 cu. ft. killed 75 per cent. of the larvae of *Ceratitis capitata* (Wied.) in the fruits.

Citrus fruits for export from Israel are normally fumigated for six hours with nitrogen trichloride against certain fungous diseases. It was found that this was compatible with ethylene-dibromide fumigation and that exposure for six hours to 6 oz. ethylene dibromide per 1,000 cu. ft. killed up to 93·5–100 per cent. of the larvae in Jaffa oranges. In large-scale tests, each involving up to 3,000 cases of fruit, exposure at 21°C. [69·8°F.] to ethylene dibromide at 6 oz. per 1,000 cu. ft. combined with nitrogen trichloride at the usual concentration killed up to 98·5 per cent. of the larvae provided that there was no leakage from the gas chamber. This concentration did not injure Jaffa or Valencia oranges, but caused slight damage to grapefruit, especially during the second half of April in over-ripe fruit not intended for export. Bromide residues on and in the treated fruits were of no significance.

BURGES (H. D.). **Some Effects of the British Climate and constant Temperatures on the Life-cycle of** *Ephestia cautella* **(Walker).**—*Bull. ent. Res.* **46** pt. 4 pp. 813–835, 5 graphs, 11 refs. London, 1956.

The following is largely the author's summary. The effect of temperature on the life-cycle of *Ephestia cautella* (Wlk.) was investigated in the laboratory and in unheated outbuildings in southern England, with emphasis on the effects of constant low temperatures and of the variable conditions of the English winter. The humidity was never low enough to have any effect on survival. Development from oviposition to adult emergence in cultures reared on wheatfeed containing 5 per cent. glycerine occupied about 64 days at 20°C. [68°F.] and about 41–45 days at 25°C. [77°F.]. The lowest temperatures at which hatching, pupation and metamorphosis from pupa to adult took place were 10–13°C. [50–55·4°F.], 8·5°C. [47·3°F.] and 10–13°C., respectively. Larvae more than half-grown were more resistant to cold than smaller larvae or eggs. The shortest exposures necessary to prevent these large larvae from completing their development were about one day at −1°C. [30·2°F.], five at 0°C. [32°F.], 32 at 5°C. [41°F.] or 83 at 10°C. Pupae completed their development at slightly lower temperatures than larvae and could survive slightly longer exposures at −1°C.

Adults survived for a mean of 18 days at about 10°C. and for successively shorter periods as temperatures decreased until at −1°C. they survived for only 1–2 days. Adult survival was also shortened at temperatures above 10°C., presumably by increased metabolism. At 35°C. [95°F.], they survived for about three days. Pairing was infrequent at 13°C. [55·4°F.] and below, and few fertilised eggs were laid at such temperatures. The highest numbers of eggs were laid at temperatures between 20 and 33°C. [91·4°F.].

When larvae more than half-grown (the overwintering stage) were exposed in a screen 18 ins. above the ground and in unheated outbuildings to the winters of 1949–50 and 1950–51, mortality was high. A few larvae completed their development early in the winter, but such survival is of little importance, since the progeny are unlikely to survive until the following summer. In outbuildings, a few of the larvae survived the winter of 1949–50, which is important, since such individuals give rise to spring adults that lay eggs at the beginning of warm weather. No larvae completed their development after exposure in a screen to the winter of 1949–50 or in the screen or outbuildings after exposure to the winter and spring of 1950–51. G. H. Mansbridge recorded survival of *E. cautella* through the winter of 1934–35 but not through that of 1935–36 [*R.A.E.*, A **25** 205]. The winter was warm in 1934–35, slightly colder in 1949–50, slightly colder than average in 1935–36 and cold in 1950–51. Several methods of comparing winter conditions in buildings are described and discussed. During the period under investigation, there was no single continuous period at temperatures below 10·5°C. [50·9°F.] that was long enough to kill by itself all the larvae in the outbuildings. A method of summing the lethal effects of the hours experienced at low temperatures is described, and it is shown that a greater number of hours was necessary to kill larvae with intermittent exposures than with continuous exposure at any one low temperature.

In outbuildings, possibly two generations of *E. cautella* can occur in a year, and a severe winter can eliminate a population. Conditions in large warehouses are more protected, and diurnal temperature changes scarcely affect large stacks of produce. In these conditions, a normal winter would not eliminate a population deep in a large mass of food, and there is a danger of cross-infestation to uninfested produce, even in winter. Opening windows and leaving a space between rows of sacks in a stack are practical means of increasing winter mortality. Cold storage is an economic method of control only for very valuable produce.

Differences in resistance to cold between different batches of insects were encountered, but the experiments were not sufficiently detailed to reveal the causes of this variation.

VAN ASPEREN (K.). **Toxicity and Interaction of Stereo-isomers of Benzene Hexachloride in Cockroaches.**—*Bull. ent. Res.* **46** pt. 4 pp. 837–843, 1 graph, 6 refs. London, 1956.

An account of experiments on the joint action on *Periplaneta americana* (L.) of the γ and δ isomers, and of the γ and α isomers, of BHC is preceded by a discussion of some types of joint action of insecticides described by other authors. The term independent action is used when the action of two poisons, A and B, is dissimilar, in that each affects a different physiological system, and there is no interaction, in that the presence of A does not influence the amount of B that reaches B's site of action or the changes produced by it there. It has been pointed out, however, that though the actions of two poisons in a mixture may be physiologically independent, the

tolerances may be correlated so that there may be no statistical independence. Thus, the mortality percentages for a combination of doses of two poisons that would give 50 and 40 per cent. kill, respectively, when applied alone, would be 50 if the coefficient of correlation of tolerances were +1, 70 if it were 0, and 90 if it were −1, provided that there was no interaction. In this instance, synergism or antagonism would be proved by mortalities higher than 90 or lower than 50 per cent., but the type of joint action can seldom be inferred from physiological facts, so that intermediate mortalities might have a variety of explanations.

In the experiments on *Periplaneta*, the mixtures and the separate isomers at the concentrations used in them were applied by injection, and the rates of mortality after various intervals of time are given and compared with those to be expected from the mixtures, if it is assumed that there is no interaction between the two poisons but that they have similar action (on the same physiological system) or have independent action with coefficients of correlation of susceptibility to them of +1, 0 and −1. It is concluded from statistical evidence that an appropriate explanation of the results is given only by the hypothesis of independent action with a strong positive correlation of the susceptibilities to the two poisons. If, however, interaction is assumed, the results can be explained by suggesting that antagonistic effects play a part in the joint action of the BHC isomers investigated. Previous experiments by the author had shown that the toxic effects of γ BHC on white mice are strongly antagonised by simultaneous administration of the δ or α isomer [*cf.* also *R.A.E.*, A **37** 15].

SOUTHWOOD (T. R. E.). **The Nomenclature and Life-cycle of the European Tarnished Plant Bug, *Lygus rugulipennis* Poppius (Hem., Miridae).**— *Bull. ent. Res.* **46** pt. 4 pp. 845–848, 25 refs. London, 1956.

The author briefly reviews the literature in which *Lygus oblineatus* (Say) and *L. pubescens* Reut. were shown to be distinct from *L. pratensis* (L.) [*cf. R.A.E.*, A **30** 398; **31** 438] and synonymous with *L. lineolaris* (P. de B.) and *L. rugulipennis* Popp., respectively [*cf.* **42** 136, 376], and states that although *L. lineolaris* is the injurious species known as the tarnished plant bug in North America, to which it is confined, it has not been clear whether this name in Europe should be applied to *L. pratensis*, as is commonly done, or to *L. rugulipennis*. The latter is recorded in papers already noticed as more abundant and widespread than *L. pratensis* on potato in Sweden [**31** 438] and the more important on wheat in Finland [**43** 398], and it is the only species on potato in Spain; both *L. rugulipennis* and *L. pratensis* have been recorded as pests of lucerne in Czechoslovakia [**37** 2]. *L. rugulipennis* is stated in letters to the author to be the more abundant on crops in Holland, Sweden and Germany. All of 22 specimens collected by G. Fox Wilson, mostly on chrysanthemum, proved to be *L. rugulipennis*, and a general collection from the Province of Kiev was found to comprise 40 specimens of *L. rugulipennis* and only three of *L. pratensis*. During 1946–49, the numbers of the two species collected at light at Rothamsted were 1,771 and four, respectively, and *L. rugulipennis* was also considerably more abundant in field collections. Although it is not always possible to be certain of the identity of the species referred to in earlier works on the biology and pest incidence of *L. pratensis* in the Palaearctic region, *L. rugulipennis* appears to be the more important there, and it is concluded that the name European tarnished plant bug should be applied to it. It has also been recorded from Alaska. Observations on the life-cycle of *L. rugulipennis* in England show that it normally has two generations a year. Eggs laid in May by overwintered females give rise to adults at the end of July, and second-generation

adults appear in September and subsequently overwinter among leaves and débris in hedge bottoms and similar situations. Populations are highest in autumn, but there is considerable winter mortality. This agrees in general with the life-cycle previously described for *L. pratensis* [*cf.* **20** 661; **26** 709].

Ward (J.) & Burt (P. E.). **The Persistence and Fate of DDT on Foliage. II.—Comparative Rates of Loss of DDT Deposits from Glass Plates and growing Leaves.**—*Bull. ent. Res.* **46** pt. 4 pp. 849–868, 4 figs., 16 refs. London, 1956.

The following is virtually the authors' summary of this part of a series [*cf. R.A.E.*, A **43** 167]. A method is described of applying even deposits of insecticide to leaves without detaching the leaves from the plants. The insecticide is sprayed by hand from an air-operated paint-spray gun under controlled conditions. Using this method for applying the insecticide, the persistence of DDT on living leaves and on glass plates was investigated. The DDT content of the deposits was estimated chemically by the Schechter-Haller method of analysis and the toxicity of the deposits was measured by allowing adults of *Tribolium castaneum* (Hbst.), confined within glass collars, to crawl on the surfaces to be tested. The deposits were found to be more toxic on leaves than on plates. This difference was shown to be due in part to the greater humidity of the environment during exposure of the test insects to deposits on leaves, as a similar enhancement of toxicity occurred when, during exposure of insects to deposits on glass or cellophane, the humidity was kept at a higher level than usual.

The rate of loss of toxicity and of DDT when deposits were exposed to sunlight in a greenhouse for varying periods within two different ranges of air temperature [*cf.* **43** 168] was studied. The deposits were derived either from emulsions or crystalline suspensions. At the lower range of air temperatures (10–21°C. [50–69·8°F.]) there was a loss, after 37 days, of about one-third of the DDT from suspension-deposits applied at the rate of 2 μg. per sq. cm. to either leaves or plates. For deposits on leaves, the losses of DDT indicated by bioassay were about equal to those found by analysis, but for deposits on plates the toxicity after exposure was markedly greater than was to be expected from the amount of DDT remaining. In another experiment within the same temperature range, but with lower rates of deposit, loss of DDT occurred more rapidly, the lower the rate of deposit, the greater being the percentage of DDT lost. Deposits from DDT emulsions, included in this experiment, behaved similarly to suspension-deposits. Suspensions only were used with the higher range of air temperatures (15–35°C. [59–95°F.]), at deposit rates of 2–8 μg. per sq. cm. Deposits were lost more rapidly from plates laid on a greenhouse bench than from living leaves, probably because the plates, as a result of insolation, were at a higher average temperature. Again, the lower the rate of deposit, the greater was the percentage lost, and the biological activity of the exposed plates, but not of the leaves, was greater than was to be expected from the amount of DDT remaining. It is concluded that the main cause of loss of p,p′DDT from crystalline deposits of the pure material exposed to sunlight in a greenhouse is the volatility of the DDT. Since the lower the rate at which the DDT is applied, the greater is the percentage lost in a given time, it is suggested that where maximum persistence of an insecticide is required, and conditions favour loss by evaporation, the insecticide should be applied at the maximum rate practicable. Loss of toxicity resulting from penetration of DDT into the leaf was too small to be of practical importance.

Ghulam-Ullah Chaudhry. **The Development and Fecundity of the Oriental Fruit Moth,** *Grapholitha* (*Cydia*) *molesta* (**Busck**) **under controlled Temperatures and Humidities.**—*Bull. ent. Res.* **46** pt. 4 pp. 869–898, 13 graphs, 29 refs. London, 1956.

Cydia (*Grapholitha*) *molesta* (Busck) has not been recorded from India or Pakistan, and since it seemed likely that the climate is unsuitable for its establishment there, its temperature and humidity requirements were investigated in the laboratory in Michigan in 1950–51. The following is substantially the author's summary of his findings.

The development and fecundity of *C. molesta* were studied at controlled temperatures of 60, 65, 75, 85 and 95°F. and relative humidities of 35, 70 and 100 per cent., eggs laid on peach twigs being transferred to partly sliced apples, in which the larvae developed, and the full-fed larvae being allowed to pupate in corrugated-paper strips. The incubation period decreased from 7–8 days at 60°F. to 2·76 days at 94°F. and then increased to 3·56 days at 95°F. Many eggs withstood exposure to 98°F. for 40 hours, but exposure for 48 hours proved fatal. Exposure for 21 hours to 105°F. reduced the viability of the eggs to 25–43 per cent. and increased the incubation period by 36–40 hours. The influence of relative humidity on the development of the eggs was significant but not well marked; it appeared to be greater on viability than on incubation period, and an almost saturated atmosphere was much more favourable than low humidity. The average feeding period of the larvae varied from 36·81 days at 65°F. to 18 at 95°F., and there were large individual variations within any given batch kept under uniform conditions. The duration of the pupal stage of non-diapause larvae decreased with rise in temperature from 19 days at 65°F. to 11 at 95°F.; the decrease was rapid at first but became very much slower at the higher temperatures. In tests in which the larvae were reared at 85°F. and the resulting pupae kept at 65°F., the latter developed more slowly than those subjected to other combinations of temperature. The pupal period was shortest at 100 and longest at 35 per cent. relative humidity, and the pupae were most viable in a saturated atmosphere at all the temperature-combinations tried. Low humidity in late summer and early autumn therefore reduces the number of moths that emerge, and damage to fruit by late broods of larvae is likely to be negligible in areas where such a condition exists.

The theoretical threshold of development for the eggs varied between 40°F. at 100 and 44°F. at 35 per cent. relative humidity, and the corresponding temperatures for pupae were 46·5 and 52·5°F.; for larvae it was 43·5°F. In moist climates, especially at relative humidities of 80–90 per cent., development can thus begin early in the spring, and high and injurious populations can in consequence be built up.

The larval diapause was either short (31–60 days) or long (over 60 days), and both occurred under various conditions of temperature and humidity. Short diapause was most frequent and most protracted among larvae that were reared at 75°F. and kept after constructing their cocoons at 75 or 85°F.; it was more frequent under dry than humid conditions when the larvae were reared at 75°F. throughout. The maximum durations of long diapause, including the pupal period, at 100 per cent. relative humidity, were 241, 184 and 179 days at 65°F. for larvae reared at 65, 85 and 75°F., respectively, and 126 days at 75°F. for larvae reared at 75°F. Emergence from diapause was most successful at 100 per cent. relative humidity, but there was an appreciable emergence at 70 per cent. Photoperiod had no appreciable effect in inducing diapause [*cf. R.A.E.*, A **39** 441], since 64·3 and 50 per cent. of larvae reared in total darkness at 65 and 75°F., respectively, completed diapause and gave rise to adults. The diapause appears to be inherent, but its initiation may be influenced to some extent by the

nature and quality of the larval food [*cf.* **28** 219; **39** 441]. At 35 per cent. relative humidity, almost all the larvae completed their development after less than a month in the cocoon. Generally about half the long-diapause larvae gave rise to adults if the relative humidity while they were in the cocoon was 100 per cent., about one-third if it was 70 per cent., and none if it was 35 per cent., though in the last case 7·7 completed their development at 75°F. This indicates that where relative humidity is low during late summer and early autumn, most of the larvae complete their development without overwintering, very few of the larvae that enter diapause survive, and, in consequence, few adults emerge in the following spring. The present geographical distribution of *C. molesta* therefore appears to be largely governed by the prevailing humidity during July–November, when the larvae enter diapause. The moth is far more abundant in humid areas than in drier ones, a difference that is explained by the influence of relative humidity on development and the completion of larval diapause.

Under controlled conditions, the optimum range of temperature for oviposition was 75–85°F. Eggs were laid by females kept in darkness, but the total number was small and the highest average per female only 12·7. Under uncontrolled laboratory conditions, the females of the overwintering generation laid very few eggs compared with those that developed from non-diapause larvae. Females that emerged from cocoons kept at low humidities were generally less fecund than those reared at high humidities, but the difference was not well marked for relative humidities between 100 and 70 per cent. Females reared and kept at room temperatures of 70–80°F. laid an average of 74·5 eggs each between 24th September and 15th October 1950; at the same temperatures, the average per female from November 1950 till April 1951, inclusive, varied from 3·3 to 9·6, and subsequently increased to 57·1 during May and to 65·4 during June. Females of successive generations laid varying numbers of eggs, even though the larvae had fed on the same food.

Meteorological data for 1948–50 for three inland peach-growing localities in the United States are compared with those for three in Pakistan. The probability that *C. molesta* might become at least a minor pest in places where the maximum temperature seldom rises above 98°F. and the relative humidity is often about 50–60 per cent., as in two of the three in Pakistan, is rather high. It is, therefore, necessary to continue strict measures to prevent its introduction.

NOTLEY (F. B.). **The *Leucoptera* Leaf Miners of Coffee on Kilimanjaro. II.—*Leucoptera caffeina* Wshbn.**—*Bull. ent. Res.* **46** pt. 4 pp. 899–912, 14 figs., 5 refs. London, 1956.

This second part of a series [*cf. R.A.E.*, A **37** 111] contains an account of the bionomics of *Leucoptera caffeina* Wshbn. on coffee, based on observation by the author in the Kilimanjaro district of Tanganyika Territory and by T. W. Kirkpatrick at Amani, some of the information in which has already been noticed [**29** 175; **30** 506; **40** 12]. *T. caffeina* occasionally causes considerable damage in the Kilimanjaro area, particularly towards the end of the year. The eggs are invariably laid in a row against the midrib or a large secondary vein on the upper surface of the leaf [*cf.* **40** 12]. There are four larval instars, and during its development each larva mines an area of about 130 sq. mm. in the leaf, which is shed if the mine is near its base and fairly large. An outbreak at Uru in 1946 caused almost complete defoliation. Pupation takes place in cocoons on the lower leaves or on weeds and fallen leaves on the ground. *L. coffeella* (Guér.) is usually present with

L. caffeina and when the larval mines coalesce, the larvae cannot be distinguished until they reach the fourth instar. Characters are given for the separation of the fourth-instar larvae and the pupae. The sex ratio in *L. caffeina* is approximately 1:1, and the adults survived for an average of 4·7 days in the laboratory and rarely for more than a week. Oviposition began soon after emergence; many females did not oviposit, and for those that did, the average and maximum numbers of eggs laid per female in one night were 16 and 54, respectively, and the average and maximum totals 24·8 and 86. The egg and larval stages lasted 5–8 and 13–23 days, respectively, and the pupal stage 5½–13 days for males and 5–10 for females; development was most rapid at about 24°C. [75·2°F.] and became more protracted as the temperature fell to 19°C. [66·2°F.] [*cf.* **37** 111; **40** 13]. *L. caffeina* appears to thrive only on *Coffea arabica*, though it attacks all species of coffee in the Kilimanjaro area; *Tricalysia* is an alternative foodplant at Amani, and *Pavetta oliveriana* and *P. ternifolia* are attacked in Bukoba [*cf.* **25** 49]. Natural mortality is low among the eggs, older larvae and pupae; but high at times among the first-instar larvae, the cause being unknown.

The fluctuations in the population of *L. caffeina* and its parasites were studied in shaded and unshaded coffee on Kilimanjaro in 1937–40 [**29** 176; **30** 507]. In unshaded coffee, *L. caffeina* is relatively rare and confined to leaves in the centre of the tree, which are shaded by the outer foliage. On shaded coffee, high populations in 1939 [**30** 507] caused severe defoliation. Trees defoliated in November–December develop new leaves and flowers in March, and subsequently set a good crop if adequate rains occur, but as no method of controlling the pest is available to enable comparative experiments to be made with undamaged trees, the ultimate effect on the crop is unknown. On both shaded and unshaded coffee, the numbers of eggs present increased towards the end of the year. The intensity of parasitism was very variable, and the fluctuations in *L. caffeina* on unshaded coffee appeared to be regulated by other factors. On shaded coffee, parasitism was very low between March–April and October–November each year. The only parasites recorded in numbers were *Pediobius* (*Pleurotropis*) *coffeicola* Ferrière and *Ageniaspis* sp., which attack the larvae, and *Eulophus borboricus* Giard and the Braconid near *Hormius*, which attack the pupae, and their relative numbers showed considerable variations. Early in 1939, when *L. caffeina* was in check, *Ageniaspis* became dominant, but as the host increased in numbers, first *E. borboricus*, then *P. coffeicola* and finally the Braconid began to increase; *P. coffeicola* became dominant, but by late February 1940, it had almost disappeared and *Ageniaspis* was again the dominant parasite. The sequence was then repeated, but at the end of November 1940, when the outbreak was coming to an end, all the parasites except *P. coffeicola* were prominent.

The occurrence of a dominant-stage condition [in which at any given time most of the insects are in the same stage of development] was less apparent from graphs of the daily emergence of *L. caffeina* than in the case of *L. coffeella* [**30** 507], but was often obvious in the field.

Potter (C.), Healy (M. J. R.) & Raw (F.). **Studies on the chemical Control of Wireworms (*Agriotes* spp.). I. The direct and residual Effects of BHC, DDT, D-D, and Ethylene Dibromide.**—*Bull. ent. Res.* **46** pt. 4 pp. 913–923, 2 pls., 35 refs. London, 1956.

The following is substantially the authors' summary. Following crop failures due to larvae of *Agriotes* spp. in a field at Rothamsted, the value of two insecticidal dusts and two soil fumigants in preventing wireworm attack

on wheat was investigated. The dusts used contained BHC or DDT, and the fumigants were ethylene dibromide and D-D (a liquid product consisting of isomeric dichloropropenes with 1,2-dichloropropane and other chlorinated hydrocarbons, the chief component being 1,3-dichloropropene). In October 1947, a dust containing 3·5 per cent. crude BHC was broadcast immediately before sowing at 7·9 lb. crude BHC (equivalent to 15·2–16 oz. γ BHC) per acre or drilled with the seed at 0·98–3·92 lb. crude BHC (1·9–8 oz. γ BHC) per acre. BHC was also applied as a seed dressing containing 20 per cent. technical γ BHC, which was used at the rate of 2 oz. per bushel of seed. A 5 per cent. DDT dust was drilled with the seed at the rate of 7·2 lb. technical DDT per acre, and mixtures of ethylene dibromide and D-D with tractor vaporising oil (1:4 and 1:1, respectively) were injected into the soil to a depth of 6 ins. 19 days before sowing by means of a special machine at 45·5 and 210 lb. chemical per acre, respectively. All treatments gave a marked increase in yield of grain over the control plots in the season following treatment. The highest yields were given by the plots treated with ethylene dibromide (32·1 cwt. per acre) and broadcast BHC (30·6 cwt. per acre) and the lowest by the plot treated with DDT (20·7 cwt. per acre); the corresponding untreated plots produced only 8·9 cwt. per acre.

In the following year, the plots were sown without further treatment, with the exception of some in which BHC had been and was again applied as a seed dressing. When judged on the criteria of crop yields in 1949–51, height and number of plants in 1948 and wireworm populations in the autumn of 1950, broadcast BHC and BHC and DDT drilled with the seeds gave the best results. The fumigants were less effective, and there was no evidence that the BHC seed dressing had any beneficial residual effect. In 1948–49, some of the plots that had been treated with BHC in the previous year were sown with lettuces, carrots, beetroot and potatoes for use in taste tests. These indicated that BHC applied to the soil by combine-drilling at 1·96 lb. per acre and upwards tainted beetroot, carrots and potatoes; potatoes were tainted when BHC was drilled at 0·98 lb. per acre. BHC applied as a seed dressing appeared to cause no tainting.

Stofberg (F. J.). **False Codling Moth of** *Citrus*.—*Fmg in S. Afr.* **29** no. 339 pp. 273–276, 294, 2 figs. Pretoria, 1954.

Argyroploce leucotreta Meyr. is a pest of *Citrus* in the eastern Transvaal. The female lays about 100 eggs, beginning 2–3 days after emergence; 3–8 are usually laid on one fruit, though as many as 65 have been found, but only 1–2 larvae survive. The larvae hatch in 4–8 days in summer and 8–14 in winter and enter the fruits, in which they feed for 25–33 days in September–March or 35–67 in April–August. When full-fed, they spin cocoons on the soil surface [*cf. R.A.E.*, A **29** 22], and the prepupal and pupal stages together last 12–24 days in September–April or 29–40 in May–August. The complete life-cycle lasts 45–60 days in August–March and 68–100 in April–July, and there are about six generations a year, the number in a given season depending on weather conditions. Records over a number of years show averages of about 5 per cent. infestation in navel and 2 per cent. in Valencia oranges. Breeding occurs in navel oranges 0·5 inch or more in diameter from November to late June and in Valencias from June onwards. Late Valencias are very heavily attacked, and off-season crops should therefore not be encouraged. The moth has numerous other food-plants, but these are of little importance, as it can breed throughout the year in mixed orchards of navel and Valencia oranges.

In small-scale tests in 1939–41, the collection of fruits showing entry

holes gave no control, but in a large-scale experiment in which one block of oranges received thorough sanitation and one none throughout 1945–50 and the treatments were reversed in 1951–53, it was found that regular destruction of infested fruits resulted in about 5 per cent. reduction in damage by *Argyroploce* and 7–9 per cent. reduction in total loss and was economically justified. In tests with insecticides, only parathion sprays afforded any control, but the small gain in sound fruits did not justify the expense; the use of parathion against Coccids is said by growers to reduce injury by *Argyroploce* considerably. Several species of parasites were observed, but none gave economic control.

Louw (B. K.). **The Control of, and the Effect of Insecticides on the Larvae of the Spotted Maize Beetle.**—*Fmg in S. Afr.* **29** no. 339 pp. 281–285, 2 figs. Pretoria, 1954.

In 1952, larvae of *Astylus atromaculatus* (Blanch.) were found attacking ripe strawberries near Pretoria on ground that had been planted with sunn-hemp [*Crotalaria juncea*], maize and strawberries in the previous year; the pollen of the first two provided food for the adults, and the sunn-hemp, which was ploughed under as green manure, served as food for the larvae. The relatively warm winter was favourable for the development of the latter, as many as 10–14 per plant being found, and about half the strawberry crop was so badly damaged as to be unmarketable. The fruits were injured only when in contact with the soil and rarely while green.

The author gives a review, partly from the literature, of the life-history of *A. atromaculatus* [*cf. R.A.E.*, A **26** 704]. The adults were found on cowpeas in early January and on maize in February and decreased considerably in numbers in March and April, probably owing to the onset of cold weather. The eggs are reported to be deposited in clusters of 30–97, in January–May, in dry curled leaves or on the ground or plant stems under dry leaves, and the larvae normally feed on decaying vegetable matter on or just below the surface of the ground. There is only one generation a year, the larvae hibernating, and the egg, larval, pupal and preoviposition periods last 12–14 days, six months or more, 13 days and about five weeks, respectively.

In tests in which dry grass was steeped in an emulsified solution of DDT and scattered under the strawberry plants on 18th September 1952, so that the fruits and leaves rested on it, observations on 7th October showed 19·5 per cent. dead larvae and no fruit damage; but it was not certain that the mortality was due to the DDT. Baits of soaked wheat impregnated with mixtures of 6·5 oz. sodium fluoride in 2 gals. water or 1 lb. calcium arsenite and 8 lb. sugar in 8 gals. water or treated with a damp mixture of 4 oz. sodium fluosilicate and 1 lb. sugar per 5 lb. were useless in competition with the strawberry fruits, but the application of 12·75 oz. 25 per cent. wettable dieldrin in 121 gals. water per acre, 5–6 inches from the stems of the plants, on 7th October caused complete mortality of the larvae by 15th October. As dieldrin has a long residual effect, the wettable powder could be scattered on the soil, harrowed in lightly and watered, before the plants are set.

Skaife (S. H.). **Dwellers in Darkness. An Introduction to the Study of Termites.**—$8\frac{3}{4} \times 5\frac{1}{2}$ ins., x + 134 pp., 14 pls., 40 figs., 13 refs. London, &c., Longmans, Green & Co., 1955. Price £1 5*s*.

This comprehensive account for the non-specialist of the life and habits of termites is based on field and laboratory observations over a period of 20

years on *Amitermes atlanticus* Fuller [*cf. R.A.E.*, A **10** 515], a species of no economic importance that constructs mounds on the mountain slopes of the Cape Peninsula, in South Africa. It includes descriptions of observation nests in which colonies were successfully kept under laboratory conditions, accounts of experiments on various aspects of termite bionomics and behaviour, and information on parasites, predators and inquilines.

Smith (L. C.). **Control of *Bryobia* Mite—recent Investigations and Recommendations.**—*J. Dep. Agric. S. Aust.* **58** no. 1 pp. 27–28. Adelaide, 1954.

Since the introduction of DDT sprays against the codling moth [*Cydia pomonella* (L.)] on apple, difficulty has been experienced in South Australia in controlling *Bryobia praetiosa* Koch. The protection given by dormant oil sprays is variable, and no effective acaricides were available against the summer stages. In 1953–54, Ovotran (p-chlorophenyl p-chlorobenzenesulphonate) and PCPBS (p-chlorophenyl benzenesulphonate) were tested. Sprays containing ¾ lb. 50 per cent. Ovotran or 1 pint 40 per cent. PCPBS emulsion concentrate per 100 gals. applied on 22nd December 1953 and again on 5th or 13th January 1954, respectively, reduced the mean number of mites per leaf on 10th February from 24·2 to 0·54 and 0·24, respectively, and the mean number of eggs per leaf from 24·2 to 2·3 and 2·7, whereas the corresponding figures for a single application of a highly refined summer oil on 22nd December were 10·3 and 17·5.

Key (K. H. L.). **The Taxonomy, Phases, and Distribution of the Genera *Chortoicetes* Brunn. and *Austroicetes* Uv. (Orthoptera: Acrididae).**—237 pp., 34 figs., 6 fldg. maps, 4 pp. refs. Canberra, Div. Ent., Commonw. sci. industr. Res. Org. Aust., 1954.

Comprehensive studies on *Chortoicetes* and *Austroicetes* spp. were made in Australia over a period of 18 years in connection with investigations on locusts and grasshoppers there, and the results, which are based on extensive field collections, principally in the south, museum specimens in Australia and elsewhere and, to some extent, the literature, are given in this monograph. The broad taxonomic relations of the genera are discussed and morphological and colour characters that are sufficiently stable to be of value in species classification, with the types of variation exhibited by them and a number of genetic variations common to several species, are described in two introductory sections. The two main sections are devoted to the two genera and their species; *C. terminifera* (Wlk.) is the only species of *Chortoicetes*, but eight species of *Austroicetes* are recognised, three of them being described as new. Synonymy and diagnostic characters are shown for both genera and species, and, for each of the species, there are detailed descriptions of the general characters, of the variations recognised (including phases where present), and, for those hitherto without allotypes, of plesio-allotypes here designated, with morphometric data, maps showing the distribution, which is discussed in relation to soil, climate and vegetation, annotated lists of all the specimens examined, and a review of the literature. A key to the species of *Austroicetes*, based on the adults, is included.

Two geographical races are recognised in both *C. terminifera* and *A. cruciata* (Sauss.). The south-western race of the former is confined to the south-west of Western Australia, and the eastern race extends over the rest of the range, which covers most of the continent. The western race of

A. cruciata occurs in the south of Western Australia, and the eastern race in parts of South Australia, New South Wales and Victoria. The only other species recorded as injurious is *A. vulgaris* (Sjöst.), of which there are two subspecies. It occurs in coastal and subcoastal areas of south-eastern and south-western Australia and has damaged crops and pastures in New South Wales and Tasmania, in association with Acridids of other genera. *A. nullarborensis*, sp. n., which occurs in parts of South Australia, the south-east of Western Australia and the extreme west of New South Wales, occasionally forms loose swarms, but is not known to migrate.

Simón F. (J. E.). **Algunas experiencias en el control de las plagas del algodonero: maíz intercalado e insecticidas sistémicos.** [Some Experiments on the Control of Cotton Pests: interplanted Maize and systemic Insecticides.]—*Inf. Estac. exp. agric. La Molina* no. 90, [22] pp., 7 figs. Lima, 1954. (With a Summary in English.)

This bulletin on the control of cotton pests in Peru is divided into three sections. In the first, the author discusses the advantages of sowing maize at intervals between the rows of cotton to encourage the breeding of natural enemies of *Heliothis virescens* (F.), a serious pest of cotton [*cf. R.A.E.*, A **39** 264]. The principal natural enemies concerned are *Paratriphleps laeviusculus* Champ., *Hyalochloria denticornis* Hsiao, *Orius tristicolor* (White) and *Rhinacloa carmelitana* Carvalho. In 1953–54, good results were obtained in the Rimac valley, near Lima, by sowing the maize and cotton at the same time, so that the maize was sufficiently well developed to attract the ovipositing females of *Heliothis*, which would otherwise have laid their eggs on the cotton. Good results were also obtained when the maize was sown about a month after the cotton, at the time of the first irrigation, for although the first generation of *Heliothis* attacked the early cotton buds, these do not usually give rise to any crop. A more complete protection was obtained by sowing some of the rows of maize with the cotton and others a month later. The spacing of the rows of maize should depend on the density of *H. virescens*, one row between every 7–15 rows of cotton being recommended. It is emphasised that the maize should be removed from the fields once the natural enemies of *Heliothis* have migrated to the cotton (about five months after sowing in the Rimac valley), since *Pococera atramentalis* (Led.), another serious pest of cotton, develops on it and pupates when the maize is about five and a half months old, the adults migrating later to the cotton.

Where *H. virescens* is the only serious pest, the control afforded by this method is sufficient, but it cannot be combined with applications of organic insecticides against other pests, especially early in the season, since these kill the predators. However, organic insecticides can be applied at the end of the season against late infestation by *Anomis texana* Ril., provided that only a part of the area is treated, so that a reserve of natural enemies is left, and that maize is sown with the cotton in the following season.

In the second section, the results are given of tests in which Systox [diethyl 2-(ethylmercapto)ethyl thiophosphate] was applied to cotton infested by *Aphis gossypii* Glov., *Thrips* sp., *Empoasca* sp., *Oligonychus* (*Tetranychus*) *peruvianus* (McG.), *Anomis texana*, *Bucculatrix thurberiella* Busck, *Anthonomus vestitus* Boh. and predacious bugs. The treatments were carried out on 13th February 1954 and comprised a spray of 0·05 per cent. Systox applied to the leaves and the addition of Systox to the irrigation water at rates of 1 and 2 cc. per linear metre of furrow. On 16th February, no examples of *Aphis*, *Empoasca*, *Thrips* or *Oligonychus* could be found on

any of the plants, though previously there had been 5–10, 0–10, 0–10 and 10–25 individuals per leaf, respectively, and none of the plants was infested by these species for 4–5 weeks following treatment, whereas infestation persisted on control plants a short distance away that had been treated with various organic insecticides or calcium arsenate with sulphur. Aphids placed on the Systox-treated plants on 13th March failed to become established. In the following week, those placed on sprayed leaves developed normally, but mortality continued until 30th March on plants that had received Systox in the irrigation water. The treatments also gave promising results against *Dysdercus ruficollis* (L.). The beneficial insects and *Anomis*, *Bucculatrix* and *Anthonomus* were not affected.

In the third section, it is stated that various insecticides were applied to cotton on 27th February and 8th March 1954 and their effects on pests and their natural enemies noted. Heptachlor controlled adults of *Anthonomus vestitus* and gave some control of *Anomis texana* and *Empoasca* sp., but it destroyed the natural enemies of *Aphis gossypii* and *Heliothis* and did not kill the Aphid or *Bucculatrix*. Isodrin killed the Aphid (and its natural enemies), *Empoasca* and *Anomis*, when the plants were very thoroughly sprayed. Chlorthion [O,O-dimethyl O-3-chloro-4-nitrophenyl thiophosphate] destroyed both the Aphid and its natural enemies and resulted in a rapid increase in the former, caused some mortality of *Anomis* and its natural enemies, and destroyed the natural enemies of *Heliothis*. Q-137 [1,1-bis(p-ethylphenyl)-2,2-dichloroethane (ethyl DDD)] destroyed the natural enemies of the Aphid and *Heliothis*, without controlling any of the pests.

Torres (B. A.). **Estudio biológico sobre** *Fidicina mannifera* **(Fab., 1803) y su importancia económica en la Argentina.** [A biological Study of *F. mannifera* and its economic Importance in Argentina.]—*Rev. Mus. Eva Perón* (N.S.) **6** (Zool.) no. 44 pp. 285–295, 4 pls., 10 figs., 11 refs. Eva Perón, 1953.

Field observations were made in 1947–48 on the bionomics of *Fidicina mannifera* (F.), a Cicadid that caused severe damage to maté tea [*Ilex paraguensis*] in Misiones, Argentina, in 1946. Its distribution is given, and all stages are briefly described. The adults were present from November to March and were most numerous in January. The females inserted their eggs in groups of 4–20 (usually eight) into the small dry twigs of maté, or the green twigs of other plants, and laid 8–12 or more batches per twig, eight being the usual number. The nymphs entered the soil to a depth of 4–6 ins. and constructed cells close to the roots of the maté, from which they extracted the sap. Nymphs in the later instars were found at depths of about two feet, but those in the last instar left the soil and attached themselves to the plants, on which the final moult took place. The chief injury is that caused by the nymphs. Their feeding weakens the plants, and the constant dampness associated with their cells, which become filled with excreta, leads to rotting of the roots, which causes the death of the plants.

Fernandez Valiela (M. V.), Bakarcic (M.) & Turica (A.). **Manual de enfermedades y plagas de los frutales y forestales en el delta del Paraná.** [A Manual of Diseases and Pests of Fruit and Forest Trees in the Paraná Delta.]—*Publ. misc. Minist. Agric. Argent.* no. 400, [1+] 192 pp., 44 pls., 11 figs., 22 refs. Buenos Aires, 1954.

Apart from an introduction containing very general notes on the importance of bacteria, fungi, insects and viruses in causing plant injury and on

the development of the first three, this manual for growers in the Paraná Delta consists of three main chapters. In the first, which occupies the greater part of the book, information is given on the pests and diseases of fruit trees and vines, arranged under the plants attacked, with notes on their recognition, importance and control, and on the bionomics of some of the insects. Forest trees are treated in the same way in the second chapter, which includes a brief section on insects that are injurious to both fruit and forest trees. The third chapter deals with fungicides and insecticides, and contains notes on the ways in which they are applied, and in some cases on their properties and the commercial preparations in which they are available. A table is included showing which of the principal materials are compatible with one another, and further tables give programmes of control measures to be applied to fruit trees and vines. Legal obligations with regard to the control of pests and diseases are briefly reviewed.

Moens (R.). **Een geval van bladrolleraantasting op seringen,** *Adoxophyes orana* **(Fisch. v. Roesl.)** (*Capua reticulana* **Hb.).** [A Case of Infestation by the Leaf-roller, *A. orana*, on Lilac.]—*Parasitica* **11** no. 1 pp. 16–20, 2 pls., 3 refs. Gembloux, 1955.

The author gives a brief account of the bionomics of *Adoxophyes orana* (Fisch. v. Roesl.) [*cf. R.A.E.*, A **41** 303], which is fairly well known as a pest of fruit trees in Belgium, and states that it caused serious damage to the flowers of lilac during forcing at Moorsel, near Brussels, in the winters of 1950–51 and 1951–52. On lilac, the larvae hibernate in shelters spun between the bases of the terminal or lateral buds, under dry leaves webbed to the stem and in cracks in the bark. Larvae overwintering on the lateral buds are probably of less importance, since they are likely to feed mostly on the laterals, which are removed as being of no commercial value. Plants are forced at 25°C. [77°F.], and the hibernating larvae become active within a few hours. After three days, when the buds begin to swell, the shelters split, and a silken web is spun between the scale-leaves of the terminal buds. The buds burst 2–7 days later, and the larvae attach themselves to the bases of the young shoots, to which they web the scale-leaves and the young leaves above them. If heavily attacked, the shoots bend over and dry up, and the larvae migrate to neighbouring shoots. As the latter develop, the larvae move towards the tip and finally web together the flower heads. These are fully formed after three weeks, at about which time the larvae become full-fed. The flowers begin to open in the fourth week, and are cut within 3–4 days. The control measures recommended in Holland [**41** 159] are summarised, but fumigation with methyl bromide is considered inadvisable owing to the risk to man. It is suggested that a winter spray before forcing and a spray of DDT, lindane [almost pure γ BHC] or parathion applied when the larvae leave their winter shelters may prove effective.

Lusis (E.). **Versuche zur Bekämpfung der Reblaus unter Erhaltung des Stockes.** [Experiments on the Control of *Phylloxera vitifoliae* with Preservation of the Stock.]—*Anz. Schädlingsk.* **27** pt. 5 pp. 71–75, 6 refs. Berlin, 1954.

In view of the recent increase in infestation by *Phylloxera vitifoliae* (Fitch) on vines in Germany [*cf. R.A.E.*, A **40** 373] and the large areas

that would have to be cleared if the general legal requirement of destruction of all vines in and around centres of infestation by the root form of this Aphid [*cf.* **42** 195] were enforced, tests on the control of the Aphids on the roots by means of soil insecticides were carried out in 1948–53 at Geisenheim on the Rhine.

In tests with carbon bisulphide as a fumigant, satisfactory control without harm to the vines was obtained in soils of moderate porosity with a single application at the rate of 72 cc. per sq. metre [about 2·1 fl. oz. per sq. yard] when this was made in spring, just before the Aphids began to oviposit. The fumigant was poured into holes about two inches deep and covered with soil, and in view of the slight lateral diffusion of the vapour, nine holes were made per sq. metre. When the results were expressed on a scale ranging from 0 for no mortality to 5 for complete kill, the figures for treatment in March and April were 4·1 and 4·3, respectively, in the region of the root collar, and 4·9 and 4·8, respectively, on the roots. Pouring part of the carbon bisulphide into a drill about two inches deep round the root collar slightly improved mortality on the collar but is not considered economic in view of the increase in labour involved. Treatment at the same and higher rates was less effective in winter and gave unsatisfactory results in summer, as in the latter case the eggs were little affected and rates of 96 cc. or more per sq. metre caused some of the vines to wilt. Since emulsions of carbon bisulphide vaporise more slowly than the pure chemical, emulsions prepared with a resin soap as the emulsifier were tested at equivalent rates of carbon bisulphide. These did not much improve the results, and, in view of the increased costs involved, they are not recommended except possibly for soils of high porosity.

Broadcast treatments with proprietary preparations of BHC proved unsatisfactory, as the BHC did not penetrate deep enough into the soil, but emulsified solutions and suspensions of BHC, also prepared from proprietary products and poured round the collar after the soil between the rows had been fumigated with carbon bisulphide at the rate of 72 cc. per sq. metre, gave complete mortality on plots treated in April, June and early August. In view of the high cost, however, this treatment is recommended only against light infestations on valuable vines.

Unsatisfactory results were given by proprietary preparations of carbon bisulphide designed to reduce the rate of vaporisation, a solution of p-dichlorobenzene, a DDT emulsified solution and various other modern organic insecticides.

Papers noticed by Title only.

Bartoloni (P.). **Appunti sulla presenza e distribuzione della** *Thercsimima ampelophaga* **Bayle-Barelle (Lepidoptera Zygaenidae) in Provincia di Pisa.** [Notes on the Presence and Distribution of *T. ampelophaga* on Vines in the Province of Pisa.]—*Ann. Fac. Agr. Pisa* (N.S.) **15** pp. 53–58, 3 figs., 2 refs. Pisa, 1954. [*Cf. R.A.E.*, A **43** 139.]

de Lotto (G.) & Nastasi (V.). **Gli insetti dannosi alle piante coltivate e spontanee dell'Eritrea. Elenco degli insetti e dei loro parassiti riscontrati negli anni 1950–53.** [The Insects injurious to cultivated and wild Plants in Eritrea. A List of the Insects and of their Parasites found in the Years 1950–53.]—*Riv. Agric. subtrop.* **49** no. 1–3 pp. 53–60, 9 refs. Florence, 1955.